UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

OFFICE OF PREVENTION, PESTICIDES, AND TOXIC SUBSTANCES

April 4, 2006

MEMORANDUM:

Subject: Revised Occupational and Residential Exposure Chapter for Ortho-phenylphenol & Ortho-phenylphenol Salts

To: Rebecca Miller, Chemical Review Manager, Reregistration Team 36
Regulatory Management Branch II
Antimicrobials Division (7510C)

AND

Najm Shamim, Risk Assessor
Regulatory Management Branch II
Antimicrobials Division (7510C)

From: Talia Milano, Chemist
Cassi Walls, Ph.D., Chemist
Risk Assessment and Science Support Branch (RASSB)
Antimicrobials Division (7510C)

Thru: Norm Cook, Branch Chief
Risk Assessment and Science Support Branch (RASSB)
Antimicrobials Division (7510C)

DP Barcode: 320537

Chemical Name:	**PC Codes:**	**CAS Registry No.**	**Abbreviation**
Ortho-phenylphenol	064103	90-43-7	OPP
Sodium ortho-phenylphenate	064104	132-27-4	OPP (Na) Salt
Potassium ortho-phenylphenol	064108	13707-65-8	OPP (K) Salt

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This document is the Occupational and Residential Exposure Chapter of the Reregistration Eligibility Decision Document (RED) for ortho-phenylphenol (OPP) and the OPP salts, which is representative of both sodium o-phenylphenate (OPP Na salt) and potassium o-phenylphenate (OPP K salt). It addresses the potential risks to humans that result from the use of these chemicals in occupational and residential settings.

At this time OPP and OPP salts are active ingredients in products such as disinfectants and deodorizers used in agricultural, food handling, commercial/institutional/industrial, residential and public access, and medical settings (Use Site Categories I, II, III, IV, and V respectively). There are also OPP and OPP salt containing products that are used for materials preservation (Use Site Category VII) and wood preservation (Use Site Category X). Examples of registered uses for OPP and salts include application to indoor and outdoor hard surfaces (e.g., walls, floors, tables, and fixtures), textiles (e.g., clothing, diapers, mattresses, bedding), carpets, air conditioner coils, agricultural tools, medical instruments, and fruits and vegetables (post-harvest). Additionally, there are registered uses for fogging and air deodorization in both occupational and residential settings. As a materials preservative, the products are used in items such as metalworking fluids, stains and paints, cleaning solutions, glues, building materials, glazes, paper, polymers, and leather. The percentage of OPP and OPP salts in various products can range from 0.0137% to 99.5%. Products containing OPP and its salts are formulated as ready-to-use solutions, pressurized sprays, soluble concentrates, impregnated wipes or as emulsifiable concentrates.

The routes of exposure evaluated in this assessment include: short-term (ST), intermediate-term (IT), and long-term (LT) dermal and inhalation exposures as well as ST and IT oral exposures. For all exposure routes, the ST NOAEL is 100 mg/kg/day and the IT/LT NOAEL is 39 mg/kg/day. A human dermal absorption factor of 43% was used in the IT and LT dermal exposures calculations because the dermal MOE calculations were based on an oral endpoint. An inhalation absorption factor of 100% was used (default value, assuming oral and inhalation absorption are equivalent) in all exposure calculations since the inhalation MOE calculations were based on an oral endpoint.

The uncertainty factor or “target” margin of exposure (MOE) for all routes of exposure and all durations is 100 for both occupational and residential scenarios. Although the target MOE is also 100 for inhalation occupational and residential scenarios, the Agency may request a confirmatory inhalation toxicity study in cases where the inhalation MOEs are below a value of 1,000 since the inhalation endpoint is based on an oral study. In the occupational assessment, intermediate-term dermal and inhalation exposures were combined together to estimate Total MOEs since the toxicity effects from the intermediate-term dermal and inhalation routes are the same while, the oral, dermal, and inhalation exposures were combined together in the residential assessment. Additionally, since the toxicological endpoints selected for both OPP and the OPP salts are identical, a separate assessment was not conducted for each active ingredient.

Based on examination of product labels describing uses for the product, it has been determined that exposure to handlers can occur in a variety of occupational and residential environments. Additionally, postapplication exposures are likely to occur in these settings.

The representative scenarios selected by the Antimicrobials Division (AD) for assessment were evaluated using maximum application rates as stated on the product labels. The maximum application rates were from products containing either OPP or OPP Na salt.

To assess the handler risks, AD used surrogate unit exposure data from the following proprietary resources: Chemical Manufacturers Association (CMA) antimicrobial exposure study, the Pesticide Handlers Exposure Database (PHED), and the proprietary sapstain study (task force # 73154), *Measurement and Assessment of Dermal and Inhalation Exposures to Didecyl Dimethyl Ammonium Chloride (DDAC) Used in the Protection of Cut Lumber (Phase III) (*Bestari et al., 1999, MRID 455243-04). Additionally, EPA's Health Effects Division's (HED) *Standard Operating Procedures (SOPs) for Residential Exposure Assessments,* MCCEM (Multi- Chamber Concentration and Exposure Model), and WPEM (Wall Paints Exposure Model) were used to estimate postapplication/bystander exposures.

Handler Risk Summary

For the residential handler dermal and inhalation risk assessment, the MOEs were above the target MOE of 100 for all scenarios. Furthermore, all of the inhalation MOEs were above 1,000 therefore a confirmatory inhalation toxicity study is **not** warranted based on the results from these scenarios.

For the occupational handler dermal and inhalation risk assessment, the MOEs were above target MOE of 100 for all scenarios except the following:

- IT exposure from fogging (mixing and loading): IT Total MOE = 98.
- ST and IT dermal exposure from wiping without gloves in the commercial/institutional premises category: ST MOE = 74, IT dermal MOE = 68, and IT Total MOE = 64.
- ST and IT dermal exposure from mopping without gloves in the medical use site category: ST dermal MOE = 93, IT dermal MOE = 84, and IT Total MOE = 78.
- ST and IT dermal exposure resulting from the gloved liquid pour of the material into textiles in the materials preservatives category: ST dermal MOE= 92, IT dermal MOE = 83 and IT Total MOE = 78.
- ST dermal exposures without gloves from painting through the use of an airless sprayer: Without gloves, the ST dermal MOE = 66. With gloves, however, the dermal ST MOE = 180 and is not of a concern.
- ST inhalation exposure from vapors of paint: ST MOE =43.

A confirmatory inhalation toxicity study may be warranted because inhalation MOEs were below 1,000 for the following scenarios:

- IT inhalation exposure from fogging (mixing and loading): IT inhalation MOE = 880
- IT inhalation exposure as a result of the blender/spray operators adding the chemical via closed-liquid pumping for wood preservation. The IT inhalation MOE = 840.

Post-application/Bystander Risk Summary

For the residential postapplication risk assessment, MOEs are above the respective target MOEs (ST/IT/LT Dermal and Inhalation = 100) for all scenarios except for the following:

- ST dermal exposure from children wearing treated clothing: The ST dermal MOE using 100% residue transfer < 1 and using 5% residue transfer = 16
- ST dermal exposure for adults wearing treated clothing: ST MOE using 100% residue transfer = 1 and using 5% residue transfer = 25.
- ST/IT/LT dermal exposure for infants wearing treated diapers: ST/IT/LT MOE using 100% residue transfer <1; ST MOE using 5% residue transfer = 11; IT/LT MOE using 5% residue transfer = 10.

A confirmatory inhalation toxicity study is may be warranted because inhalation MOEs were below 1,000 for the following scenarios:

- ST vapor inhalation exposure to adult and children in the home of a house being painted by a professional: adult ST MOE = 600 and child ST inhalation MOE = 120.
- The ST vapor inhalation exposures to adults that result from fogging applications in residential homes where MOEs were estimated for a 0-hr REI and a 4- and 24- hour exposure duration.
- The ST vapor inhalation exposure to adults that results from fogging applications in residential homes where the MOE was estimated for a 4-hr REI and 24 hour exposure duration.
- All ST vapor inhalation exposures to children that result from fogging applications in residential homes where MOEs were estimated for a 0-hr and a 4-hr REI and 2-, 4-, and 24-hr exposure durations.

For the occupational postapplication risk assessment, MOEs are above the respective target MOEs (ST/IT/LT Dermal and Inhalation = 100) for all scenarios except for the following:

- ST dermal exposure from a machinist using metalworking fluid: The ST dermal MOE = 54.

A confirmatory inhalation toxicity study is may be warranted because inhalation MOEs were below 1,000 for the following scenarios:

- IT vapor inhalation exposure from fogging a poultry barn: The IT inhalation MOE = 270, and ST inhalation MOE = 690.

Aggregate exposure risk summary

Short- and intermediate-term aggregate exposures and risks were assessed for adults and children that could be exposed to OPP and OPP salt residues from the use of products in non-occupational environments. The short-term dermal toxicity endpoint was based on skin irritation. This study is different from what the oral and inhalation endpoints were based on, such that the short-term dermal exposures were aggregated in a separate analysis from the short-term inhalation and oral exposures. However, the intermediate-term toxicity endpoints for all of the routes of exposure (oral, dermal and inhalation) are based on the same study and same toxic effect therefore, all intermediate-term routes were aggregated together. The target MOE for all routes of exposure is 100, and all of the calculated aggregate MOEs are not of concern, as further discussed in Section 5.2, "**Short and Intermediate Term Aggregate Risk.**"

Data Limitations and Uncertainties:

There are a number of uncertainties associated with this assessment and these have been reiterated from Sections 4.4.3 (residential) and 6.3 (occupational) respectively.

The data limitations and uncertainties associated with the residential handler and postapplication exposure assessments include the following:

- Surrogate dermal and inhalation unit exposure values were taken from the proprietary Chemical Manufacturers Association (CMA) antimicrobial exposure study (USEPA, 1999: DP Barcode D247642) or from the Pesticide Handler Exposure Database (USEPA, 1998) (See Appendix A for summaries of these data sources). Most of the CMA data are of poor quality therefore, AD requests that confirmatory monitoring data be generated to support the values used in these assessments.
- The quantities handled/treated were estimated based on information from various sources, including HED's Standard Operating Procedures (SOPs) for Residential Exposure Assessments (USEPA 2000, and 2001) and standard AD assumptions that can be further refined from input from registrants.
- The low pressure spray unit exposure data from PHED were used to assess outdoor applications to hard surfaces (exterior of homes). As the low pressure spray data are representative of treating low to mid level shrubs and the scenario assessed in this document represents treatments above the waist, the unit exposure value may underestimate exposure to the head and the upper body.
- The method used to estimate exposure from mouthing treated plastic toys is conservative because it does not account for washing of the toy or depletion of residue after each toy-to-mouth episode.
- The textile exposure methods were very conservative because they assumed that the textiles were saturated with the product, dried, and worn. No laundering was accounted for because the labels did not provide specific use instructions pertaining to washing of the clothing/diapers.
- A confirmatory study is needed to verify the 5% transfer factor for clothing and diapers.
- The Wall Paint Exposure Model is designed to estimate indoor-air concentrations and associated inhalation exposures for interior applications involving alkyd or latex primer/paint. The chamber tests on which the emission algorithms are based involve a limited set of chemicals with a correspondingly limited range of properties (molecular weight and vapor pressure). Further, the emission algorithms are valid only for chemicals that are formulated into alkyd/latex primers or paints. Actual monitoring data could be used to refine the exposures and risks estimated in this assessment.

The data limitations and uncertainties associated with the occupational handler and postapplication exposure assessments include:

- Surrogate dermal and inhalation unit exposure values were taken from the proprietary Chemical Manufacturers Association (CMA) antimicrobial exposure study (USEPA, 1999: DP Barcode D247642) or from the Pesticide Handler Exposure Database (USEPA, 1998) (See Appendix A for summaries of these data sources). Since the CMA data are of poor

quality, the Agency requests that confirmatory data be submitted to support the occupational scenarios assessed in this document.

- Although the data libraries contained in MCCEM are limited to residential settings, the model can be used to assess other indoor environments. For this assessment, assumptions were made regarding barn dimensions and air changes per hour. The results could be refined with actual ventilation rates. Also the half-life for the chemical would useful to refine the results.
- Currently, no exposure data are available to assess the bystanders' inhalation exposure to OPP vapors in industrial settings. Appropriate air monitoring data in the manufacturing setting are needed to support the preservative uses.

1.0 INTRODUCTION

1.1 Purpose

In this document, the Antimicrobials Division (AD) presents the results of its review of the potential human health effects of occupational and residential exposure to OPP and OPP salts. This information is for use in EPA's development of the OPP and OPP salts Reregistration Eligibility Decision Document (RED).

1.2 Criteria for Conducting Exposure Assessments

An occupational and/or residential exposure assessment is required for an active ingredient if (1) certain toxicological criteria are triggered and (2) there is potential exposure to handlers (mixers, loaders, applicators, etc.) during use or to persons entering treated sites after application is complete. For OPP and OPP salts, both criteria are met.

In this document, scenarios were assessed by using *unit exposure* data to estimate occupational and residential handlers' exposures. *Unit exposures* are estimates of the amount of exposure to an active ingredient a handler receives while performing various handler tasks and are expressed in terms of micrograms or milligrams (1mg = 1,000 µg) of active ingredient per pounds of active ingredient handled. A series of unit exposures have been developed that are unique for each scenario typically considered in assessments (i.e., there are different unit exposures for different types of application equipment, job functions, and levels of protection). The *unit exposure* concept has been established in the scientific literature and also through various exposure monitoring guidelines published by the USEPA and international organizations such as Health Canada and OECD (Organization for Economic Cooperation and Development).

Using surrogate unit exposure data, maximum application rates from labels, and EPA estimates of daily amount handled, exposures and risks to handlers were assessed. The exposure/risks were calculated using the following equations:

Daily Exposure: Daily dermal or inhalation handler exposures are estimated for each applicable handler task with the application rate, quantity treated/handled in a day, and the applicable dermal or inhalation unit exposure using the following formula:

Daily Exposure: $E = UE \times AR \times AT$ **(Eq. 1)**

Where:

E	=	Amount (mg or μg ai/day) deposited on the surface of the skin that is available for dermal absorption or amount inhaled that is available for inhalation absorption;
UE	=	Unit exposure value (mg ai/lb ai) derived from August 1998 PHED data or from 1992 CMA data;
AR	=	Maximum application rate based on a logical unit treatment, such as acres (A), square feet (sq. ft.), gallons (gal), or cubic feet (cu. ft). Maximum values are generally used (lb ai/A, lb ai/sq ft, lb ai/gal, lb ai/cu ft); and
AT	=	Normalized application area based on a logical unit treatment such as acres (A/day), square feet (sq ft/day), gallons (gal/day), or cubic feet (cu ft/day).

Daily Dose: The daily dermal or inhalation dose is calculated by normalizing the daily exposure by body weight and adjusting, if necessary, with an appropriate absorption factor. An oral endpoint was used for dermal exposures of intermediate- and long-term duration and inhalation exposures of all durations, therefore, an absorption factor of 43% was necessary for the intermediate-and long-term dermal exposures and an absorption factor of 100% was necessary for all inhalation exposures. A dermal absorption factor was not necessary for the short-term exposures because the short-term endpoint is based on a dermal study. Daily dose was calculated using the following formula:

Daily Dose: $$ADD = \frac{E \times ABS}{BW}$$ **(Eq. 2)**

Where:

ADD	=	Absorbed dose received from exposure to a chemical in a given scenario (mg active ingredient/kg body weight/day);
E	=	Amount (mg ai/day) deposited on the surface of the skin that is available for dermal absorption or amount inhaled that is available for inhalation absorption;
ABS	=	A measure of the amount of chemical that crosses a biological boundary such as lungs (% of the total available absorbed); and
BW	=	Body weight determined to represent the population of interest in a risk assessment (kg).

Margins of Exposure: Non-cancer inhalation and dermal risks for each applicable handler scenario are calculated using a Margin of Exposure (MOE), which is a ratio of the daily dose to the toxicological endpoint of concern.

Margins of Exposure: $$MOE = \frac{\text{NOAEL } or \text{ LOAEL}}{ADD}$$ **(Eq. 3)**

Where:

MOE	=	Margin of exposure, value used to represent risk or how close a chemical exposure is to being a concern (unitless);
NOAEL or LOAEL	=	Dose level in a toxicity study, where no observed adverse effects (NOAEL) or where the lowest observed adverse effects (LOAEL) occurred in the study; and
ADD	=	Average daily dose or the absorbed dose received from exposure to a chemical in a given scenario (mg ai/kg body weight/day).

In addition to the target MOEs from Table 3.2 that were used for the analysis, a series of assumptions and exposure factors served as the basis for completing the handler risk assessment. Each general assumption and factor for both residential and occupational assessments is detailed below. Assumptions specific to the use site category are listed in each separate section of this document. The general assumptions and factors include:

- OPP and OPP salt products are widely used disinfectants and have a large number of use patterns that are difficult to completely capture in this document. As such, AD has patterned this risk assessment on a series of likely representative scenarios for each use site that are believed by AD to represent the vast majority of OPP and OPP salt uses.
- Based on the adverse effects for the endpoints, the average body weight of an adult handler of 70 kg was used to complete the non-cancer risk assessment.
- Exposure factors used to calculate daily exposures to handlers were based on applicable data, if available. When appropriate data were lacking, values from a scenario deemed similar were used.
- The maximum application rates allowed by labels were assumed.

1.3 Chemical Identification

Three chemicals are considered in this document: ortho-phenylphenol, sodium o-phenylphenate and potassium o-phenylphenate. Table 1.1 shows chemical identification information for the three chemicals.

Table 1.1. Chemical Identification Information for OPP and salts

	Ortho-phenylphenol OPP	Sodium o-phenylphenate OPP (Na) Salt	Potassium o-phenylphenate OPP (K) Salt
Chemical Code	64103	64104	64108
CAS Number	90-43-7	132-27-4	13707-65-8
Molecular Formula	$C_{12}H_{10}O$	$C_{12}H_9NaO$	$C_{12}H_9KO$

1.4 Physical/Chemical Properties

Table 1.2 shows physical/chemical characteristics that have been reported for o-phenylphenate, sodium o-phenylphenate, and potassium o-phenylphenate.

Table 1.2. Physical/Chemical Properties of OPP and Salts

Parameter	OPP	OPP (Na) Salt	OPP (K) Salt
Molecular Weight	170.2 g/mol	192.19 g/mol	208.30 g/mol
Color	Colorless	White to light buff	White
Physical State	Crystallized as solid flakes	Solid (flake)	Solid
Specific Gravity	1.2	0.61-0.69	--
Dissociation Constant	9.9 at 25°C	10 at 20°C	--
pH	6.1 in aqueous solution at 22.7°C	12-13.5	--
Stability	Stable under normal conditions	Stable under controlled conditions	--
Melting Point	56-58°C	298.5°C	230.07 °C

Table 1.2. Physical/Chemical Properties of OPP and Salts			
Boiling Point	286°C	--	--
Water Solubility	700 mg/L at 25°C	60.6 g/100 mL, 53.37% (w/w)	12.4g/L
K_{ow}	3.3	0.59	0.59
Vapor Pressure	0.002 mm Hg at 25°C	1.8×10^{-9} mm Hg @ .25°C	1.91×10^{-11} mm Hg @ 25°C

2.0 USE INFORMATION

2.1 Formulation Types and Percent Active Ingredient

The products containing OPP and OPP salts as the active ingredient (a.i) are formulated as soluble concentrates, emulsifiable concentrates, ready-to-use solutions, pressurized sprays, and impregnated wipes. Concentrations of OPP and OPP salts in these products range from 0.0137% to 99.5%.

2.2 Summary of Use Pattern and Formulations

OPP and OPP salts are active ingredients in numerous disinfecting and deodorizing products and are also used as a materials preservative and a wood preservative. The majority of the products are virucidal, fungicidal, tuberculocidal, bactericidal, pseudomonacidal, or staphylocidal. The Agency determines potential exposures to handlers of the product by identifying exposure scenarios from the various application methods that are plausible, given the label uses. These scenarios are identified in Table 2.1. Based on a review of product labels, products containing OPP and salts are intended for use in agricultural, food handling, commercial/institutional/ industrial, residential and public access, and medical settings (Use Site Categories I, II, III, IV and V, respectively), as well as a materials preservative for a variety of products (Use Site Category VII) and as a wood preservative (Use Site Category X). Examples of registered uses for OPP and salts include application to indoor and outdoor hard surfaces (e.g., walls, floors, tables, and fixtures), textiles (e.g., clothing, diapers, mattresses, or bedding), carpets, air conditioner coils, and medical instruments. Additionally, there are registered uses for fogging and air deodorization. As a materials preservative, the products are used in metalworking fluids, stains and paints, glues, building materials, glazes, paper, leather, and polymers.

Table 2.1. Potential Use Scenarios Based on Product Labels for Ortho-phenylphenol and Ortho-phenylphenol salts		
Use Site Category	Example Use Sites	Scenarios
Ortho-phenylphenol		
Use Site Category I Agricultural Premises and Equipment	Poultry houses; Livestock facilities; Mushroom houses; Hatching	• Application to hard surfaces and equipment through low pressure handwand, high pressure handwand, trigger pump spray, sponge, mop, and immersion

Table 2.1. Potential Use Scenarios Based on Product Labels for Ortho-phenylphenol and Ortho-phenylphenol salts		
Use Site Category	Example Use Sites	Scenarios
	facilities; Incubators	• Application to hatching eggs through immersion, automatic washing system, foaming apparatus, low pressure handwand and fogging. • Application to fruits and vegetables post harvest as a wax through overhead brushes • Shoebaths
Use Site Categories II, II, and V Food Handling, Commercial/ Institutional/Industrial, Medical	Food processing plants; Hospitals; Public places (e.g., restaurants, hotel/motel rooms); Medical/Dental offices; Nursing home; Schools	• Application to hard surfaces through trigger pump spray, low pressure spray, aerosol spray, mop, cloth, sponge, and impregnated wipe • Application to instruments (e.g. surgical, dental and salon tools) through immersion and spray • Application to ultrasonic machines through liquid pour • Application to carpets though extraction machine, spin bonnet, and immersion • Application to textiles such as bedding, linens, and uniforms through aerosol spray, trigger pump spray, immersion • Fogging • Application to air conditioning coils • Application to conveyors in food industry as a lubricant, spray or solid applications • Air deodorization through aerosol spray • Application of paint containing OPP as a material preservative
Use Site Category VII Material Preservatives	Used in the production of various household, institutional and industrial items	• glues and adhesives • gaskets • concrete Admixes • slurries (clay, calcium carbonate, kaolin, and other filler suspensions) • ceramics • metalworking fluids • leather (shoe liners, hat bands, gloves) • polishes • photographic solutions • stains and paints • textiles • textile auxiliaries (sizing agents, spinning preparations, wetting agents) • dyes, pigments and filler suspensions • biopolymers • fire extinguishing medium • cleaning solutions • wax emulsions and polishes • paper slurries and auxiliaries • polymers and plastics • inks • other construction applications (concrete, plaster, caulk)
Use Site Category X	Used in preservation of	• Application to construction woods and fruit and

Table 2.1. Potential Use Scenarios Based on Product Labels for Ortho-phenylphenol and Ortho-phenylphenol salts		
Use Site Category	Example Use Sites	Scenarios
Wood Preservatives	wood products	vegetable pallets by non-pressure treatment methods
Use Site Category IV Residential and Public Access Premises	Homes, bathrooms, laundry rooms, trash cans	• Application to indoor hard surfaces (e.g., floors, walls) through mop, sponge, and cloth • Application to indoor household contents (trash cans, fixtures) through trigger pump spray and aerosol spray • Application to textiles such as bedding, clothing and upholstery through trigger pump spray and aerosol spray • Fogging • Application of paint containing OPP as a material preservative • Air deodorization through aerosol spray • Application to carpets and rugs though extraction machine and immersion • Application to laundry machines through liquid pour
OPP (Na) Salt		
Use Site Category I Agricultural Premises and Equipment	Poultry houses; Livestock facilities; Mushroom houses	• Application to hard surfaces and equipment through mop, cloth, pressure spray, fogger and immersion • Application to fruits and vegetables postharvest through spraying and dipping.. • Shoebaths
Use Site Categories II, III, and V Food Handling, Commercial/ Institutional/ Industrial, Medical	Hospitals; Public places (e.g., restaurants, hotel/motel rooms); Medical/Dental offices; Nursing home; Schools	• Application to hard surfaces through cloth, mop sponge, trigger pump spray, and bowl mop • Application to instruments (e.g. surgical, dental and salon tools) through immersion and spray • Application to exterior hard surfaces using an airless sprayer • Application to produce packaging containers via spray, dip or brush
Use Site Category IV Residential and Public Access Premises	Homes, bathrooms, laundry rooms, trash cans	• Application to indoor hard surfaces (e.g., floors, walls) through mop, sponge, aerosol spray, and cloth • Application to exterior hard surfaces, such as homes, using a tank-type garden sprayer • Application of paint containing OPP Na salt as a material preservative
Use Site Category VII Material Preservatives	Used in the production of for household, institutional and industrial items	• adhesives and glues • household products and construction products (caulk, bipolymers, cleaning solutions, concrete, fire extinguishing, photographic gelatins, plasters, rubber systems, wax emulsions) • paper auxiliaries and paper slurries • leather tanning • metalworking fluids, lubricants and mineral oil based products (boring and cutting oil, cooling fluids, fuel oils, hydraulic oils) • paints, coatings, and stains • pigments dyes, and filler suspensions

Table 2.1. Potential Use Scenarios Based on Product Labels for Ortho-phenylphenol and Ortho-phenylphenol salts		
Use Site Category	Example Use Sites	Scenarios
		• polymer dispersions and emulsions • textiles (carpets, felts, awnings, shower curtains, upholstery, wool protection) and textile auxiliaries • laundry starch
Use Site Category X Wood Preservatives	Used in the product of wood products	• Application to wood by non-pressure treatment methods
OPP (K) Salt		
Use Site Categories II, II, and V Food Handling, Commercial/ Institutional/ Industrial, Medical	Hospitals; Public places (e.g., restaurants, hotel/motel rooms); Medical/Dental offices; Nursing home; Schools	• Application to hard surfaces through cloth, mop sponge and spray • Application to ultrasonic machines through liquid pour • Application to instruments (e.g. surgical, dental and salon tools) through immersion and spray
Use Site Category IV Residential and Public Access Premises	Bathrooms	• Application to hard surfaces through aerosol spray

From Table 2.1, AD selected representative exposure scenarios to assess in this document. These scenarios were selected to be representative of the vast majority of uses and are believed to provide high-end degrees of dermal, inhalation, or incidental ingestion exposure. The representative scenarios assessed in this document are shown in Table 4.1 (residential) and Table 6.1 (occupational).

3.0 SUMMARY OF TOXICITY DATA

3.1 Acute Toxicity

Adequacy of database for Acute Toxicity: The acute toxicity database for ortho-phenylphenol and salts is considered incomplete. Acute dermal toxicity (870.1200), acute inhalation toxicity (870.1300), and primary eye irritation studies must be submitted. Ortho-phenylphenol has a moderate order of acute toxicity via the oral route of exposure (Toxicity Category III). For dermal irritation, ortho-phenylphenol and its sodium salt are severe (Toxicity Cateogry I) and moderate to severe (Toxicity Category II) irritants, respectively. Ortho-phenylphenol and its sodium salt are not dermal sensitizers. The acute toxicity data for ortho-phenylphenol and salts is summarized below in Table 3.1.

Table 3.1. Acute Toxicity Profile for Ortho - Phenylphenol and Salts				
Guideline Number	**Study Type/ Test substance (% a.i.)**	**MRID Number/ Citation**	**Results**	**Toxicity Category**

Table 3.1. Acute Toxicity Profile for Ortho - Phenylphenol and Salts				
Guideline Number	**Study Type/ Test substance (% a.i.)**	**MRID Number/ Citation**	**Results**	**Toxicity Category**
870.1100 (§81-1)	Acute Oral Toxicity - Rat 2-phenylphenol, purity 99.9%	43334201	LD_{50} = 2733 mg/kg	III
870.1100 (§81-1)	Acute Oral Toxicity - Rat 2-phenylphenol, sodium salt purity 99.1%	433342402	LD_{50} = 846 mg/kg (male) LD_{50} = 591 mg/kg (female)	III
870.1200 (§81-2)	Acute Dermal Toxicity	NS	NS	---
870.1300 (§81-3)	Acute Inhalation Toxicity	NS	NS	---
870.2400 (§81-4)	Acute Eye Irritation	NS	NS	---
870.2500 (§81-5)	Acute Dermal Irritation- Rabbit 2-phenylphenol purity 99.9%	43334202	Dermal irritant	I
870.2600 (§81-6)	Dermal Sensitization - Guinea pig 2-phenylphenol, purity 99.9%	43334203	Non sensitizer.	NA
870.2600 (§81-6)	Dermal Sensitization - Guinea pig 2-phenylphenol, sodium salt purity 99.1%	43334205	Non sensitizer.	NA

3.2 Summary of Toxicity Endpoints

Table 3.2 summarizes the toxicological endpoints for OPP and OPP salts and has been extracted from the toxicological chapter of this RED (USEPA, 2006). The toxicological endpoints selected for OPP and OPP salts are identical.

Table 3.2 Summary of Toxicological Doses and Endpoints for Ortho-Phenylphenol for Use in Human Risk Assessments			
Exposure Scenario	Dose Used in Risk Assessment (mg/kg/day)	Target MOE, UF, Special FQPA SF, for Risk Assessment	Study and Toxicological Effects
Dietary Risk Assessments			
Acute Dietary (general population and females 13-49)	No appropriate endpoints were identified that represent a single dose effect. Therefore, this risk assessment is not required.		
Chronic Dietary (all populations)	**NOAEL** = 39 mg/kg/day	**FQPA SF** = 1 **UF** = 100 (10x inter-species	Combined oral toxicity/carcinogenicity study in rats (MRID 43954301, 44852701, 44832201)

Table 3.2 Summary of Toxicological Doses and Endpoints for Ortho-Phenylphenol for Use in Human Risk Assessments			
Exposure Scenario	Dose Used in Risk Assessment (mg/kg/day)	Target MOE, UF, Special FQPA SF, for Risk Assessment	Study and Toxicological Effects
		extrapolation, 10x intra-species variation) **Chronic RfD** = 0.39 mg/kg/day **Chronic PAD** = 0.39 mg/kg/day	LOAEL of 200 mg/kg/day based upon decreased body weight, body weight gain, food consumption and food efficiency, increased clinical and gross pathological signs of toxicity.
Non-Dietary Risk Assessments			
Incidental Oral Short-Term (1 - 30 days)	**NOAEL (maternal)** = 100 mg/kg/day	**Target MOE** = 100 **FQPA SF** = 1 **UF** = 100 (10x inter-species extrapolation, 10x intra-species variation)	Developmental (gavage) toxicity studies in rats (MRID 00067616, 92154037) and rabbits (MRID 41925003; co-critical developmental toxicity study) Maternal LOAEL of 300 mg/kg/day based upon clinical observations of toxicity, decreased weight gain, food consumption and food efficiency observed in the rat developmental toxicity study.
Incidental Oral Intermediate-Term (1 - 6 months)	**NOAEL** = 39 mg/kg/day	**Target MOE** = 100 **FQPA SF** = 1 **UF** = 100 (10x inter-species extrapolation, 10x intra-species variation)	Combined oral toxicity/carcinogenicity study in rats (MRID 43954301, 44852701, 44832201) LOAEL of 200 mg/kg/day based upon decreased body weight, body weight gain, food consumption and food efficiency, increased clinical and gross pathological signs of toxicity.
Dermal Short-Term (1 - 30 days) (residential and occupational)	**NOAEL (dermal)** = 100 mg/kg/day (7872 ug/cm^2)[c]	**Target MOE** = 100 **FQPA SF** = 1 **UF** = 100 (10x inter-species extrapolation, 10x intra-species variation)	21-Day Dermal toxicity study in rats (MRID 42881901) LOAEL (dermal) of 500 mg/kg/day based upon dermal irritation (erythema, scaling) at the site of test substance application.
Dermal Intermediate- and Long-Term (1 - 6 months and >6 months) (residential and occupational)	**NOAEL** = 39 mg/kg/day[a]	**Target MOE** = 100 **FQPA SF** = 1 **UF** = 100 (10x inter-species extrapolation, 10x intra-species variation)	Combined oral toxicity/carcinogenicity study in rats (MRID 43954301, 44852701, 44832201) LOAEL of 200 mg/kg/day based upon decreased body weight, body weight gain, food consumption and food efficiency (effects observed as early as 13 weeks in this study), increased clinical and gross pathological signs of toxicity.
Inhalation Short-Term	**NOAEL (maternal)** = 100 mg/kg/day[b]	**Target MOE** = 100	Developmental (gavage) toxicity studies in rats (MRID 00067616, 92154037) and

Table 3.2 Summary of Toxicological Doses and Endpoints for Ortho-Phenylphenol for Use in Human Risk Assessments			
Exposure Scenario	Dose Used in Risk Assessment (mg/kg/day)	Target MOE, UF, Special FQPA SF, for Risk Assessment	Study and Toxicological Effects
(1 - 30 days) (residential and occupational)		**FQPA SF** = 1 **UF** = 100 (10x inter-species extrapolation, 10x intra-species variation) **DB UF** = an additional 10x is necessary for route extrapolation. If results are below an MOE of 1,000, a confirmatory inhalation study is warranted.	rabbits (MRID 41925003; co-critical developmental toxicity study) Maternal LOAEL of 300 mg/kg/day based upon clinical observations of toxicity, decreased weight gain, food consumption and food efficiency observed in the rat developmental toxicity study.
Inhalation Intermediate- and Long-Term (1 - 6 months and >6 months) (residential and occupational)	**NOAEL** = 39 mg/kg/day[b]	**Target MOE** = 100 **FQPA SF** = 1 **UF** = 100 (10x inter-species extrapolation, 10x intra-species variation) **DB UF** = an additional 10x is necessary for route extrapolation. If results are below an MOE of 1,000, a confirmatory inhalation study is warranted.	Combined oral toxicity/carcinogenicity study in rats (MRID 43954301, 44852701, 44832201) LOAEL of 200 mg/kg/day based upon decreased body weight, body weight gain, food consumption and food efficiency (effects observed as early as 13 weeks in this study), increased clinical and gross pathological signs of toxicity.
Cancer (oral, dermal, inhalation)	**Classification:** *ortho*-Phenylphenol is classified as "Not likely to be carcinogenic below a specific dose range", without quantification of risk.		

UF = uncertainty factor, DB UF = data base uncertainty factor, FQPA SF = special FQPA safety factor, NOAEL = no observed adverse effect level, LOAEL = lowest observed adverse effect level, PAD = population adjusted dose (a = acute, c = chronic), RfD = reference dose, MOE = margin of exposure

[a] A human dermal absorption factor of 43% is used because an oral endpoint was selected for the intermediate- and long-term dermal exposure scenarios.

[b] The inhalation absorption factor of 100% (default value, assuming oral and inhalation absorption are equivalent) should be used since an oral endpoint was selected for the inhalation exposure scenarios.

[c] $\frac{100\text{mg}}{\text{kg}} \times \frac{200\text{g}}{\text{rat}} \times \frac{1\text{ sq. in}}{2.54\text{ sq.cm}} = 7874\text{ ug/cm}^2$

3.3 FQPA Considerations

Developmental Toxicity Study Conclusions:

Developmental toxicity studies for ortho-phenylphenol are available in both the rat and rabbit, as summarized in this toxicology chapter. Both studies were well conducted and considered acceptable by the Agency. The examination of these studies shows that adverse effects in offspring occurred at doses higher than those producing maternal toxicity. In addition, the effects on offspring were not considered more severe than those occurring in maternal animals. Therefore, there is no increased concern for developmental toxicity of ortho-phenylphenol when comparing effects in adult animals with those in offspring. This conclusion is similar to that reached by the Department for Environment, Food and Rural Affairs of the Pesticides Safety Directorate in their 1993 publication on the Evaluation of 2-phenyl phenol.

Reproductive Toxicity Study Conclusions:

An acceptable two-generation reproduction toxicity study conducted according to Agency guidelines is available for ortho-phenylphenol. There were no toxicologically significant effects on reproductive parameters in this study. Therefore, there is no increased concern for potential reproductive toxicity of ortho-phenylphenol.

Information from Literature Sources:

Peer reviewed scientific literature is available on both the reproductive and developmental toxicity of ortho-phenylphenol (IPCS, 1999). None of these studies indicates increased concern for developmental or reproductive toxicity of ortho-phenylphenol.

Pre-and/or Postnatal Toxicity:

(a) Determination of Susceptibility

From the available data submitted to the Agency and the available peer reviewed scientific literature on developmental and reproductive toxicity, there was no increased concern for susceptibility from exposure to ortho-phenylphenol.

(b) Degree of Concern Analysis and Residual Uncertainties

There are no residual uncertainties identified from examination of the available data on developmental and reproductive toxicity of ortho-phenylphenol. Available submitted studies are well-conducted and identify clear dose-response relationships for parental and offspring toxicity. Peer reviewed literature supports the findings of the submitted studies.

(c) Proposed Hazard-based Special FQPA Safety Factor(s):

The special hazard-based FQPA safety factor can be reduced to 1x for ortho-phenylphenol.

Recommendation for a Developmental Neurotoxicity Study:

There is no need for a developmental neurotoxicity study with ortho-phenylphenol at this time.

The available data show no significant neurotoxic effects from administration of the chemical in experimental animal studies.

4.0 RESIDENTIAL EXPOSURE ASSESSMENT

4.1 Summary of Registered Uses

Some products containing OPP and OPP salts are labeled for residential uses such as disinfectants and deodorizers. These products are for use on indoor and outdoor hard surfaces (e.g., floors, walls, bathroom fixtures, trash cans, household contents), textiles (e.g., clothing, diapers, and bedding), and carpets. There are also fogging products and aerosol air deodorizing products which can be used in the home. Additionally, residents may be exposed to household items that have been treated with OPP and OPP salts through material preservation (i.e., paints and plastics). Table 2.1 presents a summary of all exposure scenarios that may occur from the residential use site category based on examination of product labels. Table 4.1 identifies the representative exposure scenarios assessed in this document.

4.2 Dietary Exposure

Any risks pertinent to dietary exposures are discussed in the Preliminary Risk Assessment.

4.3 Drinking Water Exposure

Any risks pertinent to drinking water exposures are discussed in the Preliminary Risk Assessment.

4.4 Residential Exposure

The exposure scenarios assessed in this document for the representative uses selected by AD are shown in Table 4.1. The table also shows the maximum application rate associated with the representative use and the EPA Registration number for the corresponding product label. For handlers, the representative uses assessed through direct product application to indoor hard surfaces (mopping, wiping, and aerosol foam spray), outdoor hard surfaces (tank-type garden sprayer), textiles (trigger pump spray), and air deodorization (aerosol spray). Additionally, handler exposures were assessed for the application of already treated paint (paint brush/roller and airless sprayer). It should be noted, for the calculation of application rates in which 8.34 lb a.i./gal is noted, the product was assumed to have the density of water because no product-specific density was available.

Table 4.1. Representative Uses Associated with Residential Exposure

Representative Use	Exposure Scenario	Application Method	Registration #	Application Rate

Table 4.1. Representative Uses Associated with Residential Exposure				
Representative Use	Exposure Scenario	Application Method	Registration #	Application Rate
Indoor Hard Surfaces	ST Handler: Dermal and Inhalation; ST and IT Post-app[1,9]: child incidental ingestion and dermal	Mopping	40510-5 (OPP Salt)	0.126 lb a.i./diluted gal (8 oz. product / 4 gal water x 97% a.i. x 8.34 lb/gal x 1 gal/128 oz)
	ST Handler: Dermal and Inhalation	Wiping		
	ST Handler: Dermal and Inhalation	Aerosol foam spray[3]	777-27 (OPP)	0.42% a.i. by weight
Outdoor Hard Surfaces (i.e. exterior house cleaner)	ST Loader and Handler: Dermal and Inhalation	Tank type garden sprayer (i.e. low pressure sprayer)	71240-1 (OPP Salt)	0.00104 lb a.i./gal (0.25 gal product / 5 gal water x 0.25% a.i. x 8.34 lb/gal: assuming product has the density of water)
Textiles (i.e., clothing and cloth diapers)	ST Handler: Dermal and Inhalation ST Post-app: adult dermal; child incidental ingestion and dermal IT/LT Post-app: child dermal (diaper)	Trigger pump spray[3]	10088-105 (OPP)	0.0208 lb ai/gal (0.249% ai x 8.34 lb/gal)
Air Deodorization	ST Handler: Dermal and Inhalation Post-app: adult (ST) and child (ST and IT)[1] inhalation [2]	Aerosol spray	44446-67 (OPP)	0.199% a.i. by weight
Fogging	ST Post-app: adult and child inhalation (vapor)[8]	Fogger	70263-3 [5] (OPP)	0.019 lb a.i./ 6000 ft^2 (0.22% a.i. x 1 gal product/6000 ft^2 x 8.34 lb/gal)
Using Treated Plastic/polymer products (i.e., toys)	ST Post-app: child incidental ingestion	NA	67869-24 (OPP salt)	0.34% a.i. by weight of material to be preserved
Using Treated Paint	ST Handler: Dermal and Inhalation (aerosol and vapor)[6] ST Post-app: adult and child inhalation (vapor) [7]	Paint brush, rollers, airless sprayer	67869-24 (OPP salt) and 464-126 (OPP)	0.56% a.i. by weight of material to be preserved 0.5% a.i. by weight of material to be preserved

ST = Short-term exposure, IT = Intermediate-term exposure
[1]IT post-application exposures for children were assessed because that this product could be used in a commercial day care facility.
[2] Since this application rate is for OPP, which has a relatively high vapor pressure, it was necessary to assess post-application inhalation exposure to the vapor. OPP salts have a much lower vapor pressure and will not readily volatilize.
[3] The aerosol spray was chosen to represent the aerosol foam product and trigger pump spray product because it is expected that they have similar unit exposures.
[4] The post-app exposure is represented by the post-app exposure scenario for air deodorization.
[5] Label Reg # 70263-3 can be used in household settings by commercial applicators; therefore, a postapplication scenario was assessed using the %ai from this product. However, the application rate from another label (#65020-7) for lack of better data. Note: Reg # 65020-7 also can be used in schools.
[6] Handler dermal and inhalation (to the particulates) exposure were assessed for OPP salts using PHED unit exposures. WPEM (Wall Paint Exposure Model) was also used to assess the vapors of OPP for residential handlers because of the high vapor pressure of OPP.
[7] Post-application inhalation exposures to the vapor were assessed for only the OPP product because of its high vapor pressure.
[8] For the fogging scenario, child post-application incidental ingestion or dermal exposures were not assessed because they were assessed for the mopping application. The mopping application has a much higher application rate (in terms of lb ai/ft^2) than the fogging application. It should also be noted that although the fogging application can occur in child care facilities, the intermediate-term duration was not assessed because it was assumed that the fogging application would be used primarily in areas damaged by smoke, fire, floods, or sewage backups and these incidents do not occur on a continuous basis.
9[7] This label, # 40510-5 states that the product can be used for "housekeeping sanitization" and to "sanitize latrine: buckets, urinals, toilet bowls, walls, shower stalls, garbage cans, and garbage platforms." This is why it is assumed to not be used in daycares. It does not specifically say "commercial and institutional premises."

4.4.1 Residential Handler Exposures

The residential handler scenarios described in Table 4.1 were assessed to determine dermal and inhalation exposures. The majority of the scenarios were assessed using CMA data and Equations 1-3 in Section 1.2, "Criteria for Conducting Risk Assessment." However, for handlers using paint, two approaches were used to determine inhalation exposure. CMA data were used to determine inhalation exposure to aerosolized particles of paint (assessed below). To assess the inhalation exposure to OPP vapor, EPA's Wall Paint Exposure Model (WPEM) was used (see Section 4.4.1.1).

The assumptions and factors used for those scenarios in which CMA data were used include:

Unit Exposure Values: Unit exposure values were taken from the proprietary Chemical Manufacturers Association (CMA) antimicrobial exposure study (USEPA, 1999: DP Barcode D247642) or from the PHED data presented in HED's Residential SOPs (USEPA, 1997).

- For the ***mopping*** scenario, the CMA dermal and inhalation unit exposure values for ungloved mopping were used (71.6 mg/lb a.i. and 2.38 mg/lb a.i., respectively). These values are based on data collected from six replicates mopping floors and receiving exposure via contact with the mop or with the bucket.
- For the ***wiping*** scenario, the CMA dermal and inhalation unit exposure values for ungloved wiping were used (2,870 mg/lb a.i. and 67.3 mg/lb a.i., respectively). These values are based on data collected from six replicates (dental technicians) who used a finger pump sprayer to apply the product and then wiped the surfaces with a paper towel.

- For ***aerosol foam spray, trigger pump*** and ***air deodorization*** scenarios, the PHED dermal and inhalation unit exposure values are 220 mg/lb a.i. and 2.4 mg/lb a.i., respectively. The values are based on homeowners applying an aerosol insecticide to baseboards in kitchens and are representative of a handler wearing short pants and a short sleeve shirt, with no gloves.
- For the ***tank type garden sprayer*** scenario, the PHED dermal and inhalation unit exposure values for a residential handler pouring a pesticide and applying it via a low pressure sprayer. These ungloved unit exposure values (100 mg/lb a.i. for dermal and 0.030 mg/lb a.i. for inhalation) represent a handler treating low and mid-level targets (generally below the waist) while wearing short pants and a short sleeve shirt, with no gloves.
- For the ***airless sprayer*** scenario, PHED dermal and inhalation unit exposure values for a residential handler applying a pesticide using an airless sprayer were used. These unit ungloved exposure values (79 mg/lb a.i. for dermal and 0.83 mg/lb a.i. for inhalation) represent a handler painting a residential bathroom wearing short pants and a short sleeve shirt, with no gloves.
- For the ***brush/roller*** scenario**,** PHED dermal and inhalation unit exposure values for a residential handler applying a pesticide using a paint brush were used. These unit exposure values (230 mg/lb a.i. for dermal and 0.28 mg/lb a.i. for inhalation) represent a handler wearing short pants and a short sleeve shirt, with no gloves.

Quantity handled/treated: The quantities handled/treated were estimated based on information from various sources and assumptions.

- For the ***mopping*** scenarios, it is assumed that 1 gallon of diluted solution is used.
- For the ***wiping and trigger pump spray*** scenarios, it is assumed that 0.5 liter (0.13 gal) of diluted solution is used.
- For the ***aerosol foam spray*** and ***air deodorization*** scenarios, it is assumed that one can of product is used. For the aerosol foam spray (EPA Registration No. 777-27), the product contains a net weight of 14 oz (0.875 lbs). For the air deodorization product (44446-67), the product contains a net weight of 16.5 oz (1.03 lbs).
- For the ***tank type (low pressure spray) garden sprayer*** in ***outdoor hard surface applications***, it is assumed that 5 gallons of dilute product will be used.
- For the ***airless sprayer*** in ***paint applications***, it is assumed that 150 lbs (approximately 15 gallons) of treated paint will be used. This is based on the coverage of 200 ft^2/gallon and a house size of 40 x 30 x 20 ft (surface area of 2,800 ft^2).
- For the ***brush/roller*** in ***paint applications***, it is assumed that 20 lbs (approximately 2 gallons) of treated paint will be used. This is based on the 90^{th} percentile value of 8 gallons of latex paint used per year divided by the mean frequency of 4 painting events/year.

Duration of Exposure: The duration of exposure for most homeowner applications of disinfectant/deodorizing and paint products is believed to be best represented by the short-term duration (1 to 30 days). The reason that short term duration was chosen to be assessed is because the different scenarios (i.e. methods of application) are assumed to be episodic, not daily. In addition, homeowners are assumed to use different cleaning products with varying actives, not exclusively OPP or OPP Salt treated products.

Results

The resulting short-term exposures and MOEs for the representative residential handler scenarios are presented in Table 4.2. The calculated MOEs were above the target dermal and inhalation MOE of 100 for all scenarios. Furthermore, all short-term inhalation MOEs exceeded 1,000 therefore, a confirmatory inhalation toxicity study is **not** warranted based on the results of these exposure scenarios.

Table 4.2 Short-Term OPP & Salts Residential Handlers Exposures and MOEs

Exposure Scenario	Method of Application	Unit Exposure (mg/lb ai)		Application Rate	Quantity Handled/ Treated per day	Absorbed Daily Dose (mg/kg/day)		MOE (ST)	
		Dermal[a]	Inhalation			Dermal[b]	Inhalation[c]	Dermal (Target = 100)[d]	Inhalation (Target = 100)[e]
Application to indoor hard surfaces	Mopping	71.6	2.38	0.126 lb ai/gallon	1 gallons	0.1289	0.0043	780	23,000
	Wiping	2870	67.3	0.126 lb ai/gallon	0.13 gallons	0.6716	0.0157	150	6,300
	Aerosol Foam Spray	220	2.4	0.42 % ai by weight	0.875 lbs	0.0116	0.0001	8,700	7.90×10^{5}
Application to outdoor hard surfaces (i.e. exterior of homes)	Tank Type Low Pressure Garden Sprayer	100	0.03	0.00104 lb ai/gallon	5 gallons	0.01	0.00016	13,000	4.5×10^{7}
Application to textiles	Trigger Pump Spray	220	2.4	0.0208 lb ai/gallon	0.13 gallons	0.085	0.0065	12,000	1.10×10^{6}
Air deodorization	Aerosol Spray	220	2.4	0.199% ai by weight	1.03 lbs	0.0064	7×10^{-5}	16,000	1.4×10^{6}
Painting	Brush/roller	230	0.284	0.56% ai by weight	20 lb s (2 gal)	0.368	0.0005	270	220,000
	Airless sprayer	79	0.83	0.56% ai by weight	150 lbs (15 gal)	0.948	0.01	110	10,000

a All dermal unit exposures represent ungloved replicates. The aerosol spray, tank-type garden sprayer (i.e., low pressure sprayer), trigger pump sprayer, brush/roller, and airless sprayer unit exposures represent short sleeve and short pant replicates. The mopping, wiping, and liquid pour represent long pant and long shirt replicates.

b Dermal Daily Dose (mg/kg/day) = [dermal unit exposure (mg/lb ai) * application rate * quantity handled / body weight (70 kg).

c Inhalation Daily Dose (mg/kg/day) = [inhalation unit exposure (mg/lb ai) * application rate * quantity handled / body weight (70 kg).

d Dermal MOE = NOAEL (100 mg/kg/day) / Daily Dose. Target dermal MOE is 100.

e Inhalation MOE = NOAEL (100 mg/kg/day) / Daily Dose. Target inhalation MOE is 100.

4.4.1.1 Residential Painter Inhalation (vapor) Exposure

The residential painter inhalation exposure to aerosolized paint was assessed in the previous section, 4.4.1. In this section, the painter inhalation exposure to chemical vapor from the paint is assessed. AD utilized EPA's Wall Paint Exposure Model (WPEM) version 3.2 to estimate air concentrations resulting from the use of paint preserved with OPP. WPEM was

developed under a contract by Geomet Technologies for EPA OPPT to provide estimates of potential air concentrations and consumer/worker exposures to chemicals emitted from wall paint which is applied using a roller or a brush. WPEM uses mathematical models developed from small chamber data to estimate the emissions of chemicals from oil-based (alkyd) and latex wall paint. The emission data can then be combined with detailed use, workload and occupancy data (e.g., amount of time spent in the painted room, etc,) to estimate exposure. Specific input parameters include: the type of paint (latex or alkyd) being assessed, density of the paint (default values available), and the chemical weight fraction, molecular weight, and vapor pressure. Detailed information and the executable model can be downloaded from http://www.epa.gov/opptintr/exposure/docs/wpem.htm.

For this exposure assessment, the WPEM default scenario for the homeowner painter (RESDIY) was used. This WPEM default scenario assumes that the homeowner is exposed to the chemical in paint when painting the bedroom of a house. For a detailed description of the default RESDIY scenario, see the WPEM User's Guide. The following chemical-specific inputs were used in the model:

- OPP's molecular weight (170.19 amu) and vapor pressure (0.002 mm Hg)
- The weight fraction of OPP in paint (product #464-126 contains 0.5% OPP)

The model provides several dose measures (i.e., LADD, ADD), air concentration measures (i.e., peak, 15-min, 8hr), and a comma-separated (.csv) file as outputs. The comma-separated file contains details on time-varying concentrations within the modeled building as well as concentrations to which the individual is exposed. This file can be read directly into spreadsheet software (e.g., Excel) for calculating additional summary statistics. The air concentrations outputted by the model were used by AD to estimate inhalation exposure doses and MOEs. The model results and exposure calculations are summarized in Table 4.3.

Since a homeowner or do-it-yourself painter typically paints on an intermittent basis (i.e., once or twice a year), it was necessary to assess exposure for only the short-term duration. The inhalation (vapor) MOE for the short-term exposure for the DIY painter is above the target MOE of 100.

Table 4.3. Short-Term Inhalation (vapor) Exposure and MOE for Residential Painters

Exposure Duration (hrs)	Average Air Conc. (mg/m^3)[a]	Inhal. Rate (m^3/hr)[b]	Inhalation Dose (mg/kg/day)[c]	ST Inhal. MOE
3	1.15	1.00	0.0493	2,000

[a] The average air concentration for 3 hours of exposure (during the painting activities only) (see Appendix E, Table for Air Conc for DIY)
[b] Inhalation rate for light activity in the Exposures Factor Handbook (USEPA, 1997)
[c] Inhalation Dose = Exposure Duration x Air Concentration x Inhalation Rate/ Body Weight (70 kg for adults)
[d] Short-Term Inhalation MOE = Short-Term Inhalation NOAEL (100 mg/kg/day) / Inhal. Dose where Target MOE = 100

4.4.2 Residential Post-application Exposures

For the purposes of this screening level assessment, postapplication scenarios have been developed that encompass multiple products, but still represent a high end exposure scenario for all products represented. As shown in Table 4.1, representative postapplication scenarios assessed include contacting treated hard surfaces/floors (dermal and incidental oral exposure to children), wearing treated clothing (dermal exposure to adults and children), wearing treated diapers (dermal exposure to infants), mouthing treated textiles such as clothing and blankets (incidental oral exposure to children), and mouthing treated plastic toys (incidental oral exposure to infants). Additionally, postapplication/bystander inhalation exposures were assessed for use of the disinfecting/deodorizing products (vapor exposure to adults and children) and paints (vapor exposure to adults and children).

Typically, most products used in a residential setting result in exposures occurring over a short-term time duration (1 to 30 days). This assumption is supplemented with the idea that the different scenarios (i.e. methods of application) are episodic, not daily. In addition, homeowners are assumed to use different cleaning products with varying actives, not exclusively OPP or OPP Salt treated products. If the products are used on a routine basis (i.e., once a week) and the active ingredient has a long indoor half-life, exposures may occur over an intermediate-term time duration (30 days – 6 months). At this time, AD does not have residue dissipation data or reliable use pattern data, including the frequency and duration of use of antimicrobial products in the residential setting. AD does not believe that the use patterns of many residential products result in intermediate-term exposure. However, AD does believe that intermediate-term exposure to children may occur in day care centers where disinfecting products are used more frequently. Additionally, AD also believes that exposures will occur on a continuous basis for infants wearing treated diapers therefore, short-, intermediate- and long-term (greater than 6 months) exposures were necessary to assess for this scenario.

4.4.2.1 Hard Surface/Floor Cleaners

Dermal Exposure to Children from Treated Floors

Exposure Calculations

There is the potential for dermal exposure to toddlers crawling on hard floors after mopping with OPP and OPP salts products. Exposures and MOEs were calculated for

children contacting treated hard surface floors in residential homes (short-term exposure) and in commercial daycare centers (intermediate-term exposure). To determine toddler exposure to floor residues (mopping), the following equation was used:

$$PDD = \frac{AR \times DTF \times DRF \times CF1 \times CF2 \times SA}{BW}$$

where,

PDD	=	Potential daily dose;
AR	=	Application Rate (lb/ft^2);
DTF	=	Dermal transfer factor (fraction, unitless);
DRF	=	Disinfectant fraction remaining on floor (unitless);
CF1	=	Conversion factor ($4.54x10^5$ mg/lb);
CF2	=	Conversion factor (10.8 ft^2/m^2);
SA	=	Surface area of the body which is in contact with floor (m^2); and
BW	=	Body weight (kg)

Assumptions

- Toddlers (3 years old) were used to represent the 1 to 6 year old age group. A body surface area of 0.657 m^2 and a body weight of 15 kg was been assumed, which are the median values for 3 year olds (USEPA, 1997).
- The labels did not provide information on the volume of disinfectant to be used for cleaning surfaces such as floors. It was assumed that the diluted treatment solution is applied at a rate of 1 gallon per 1,000 sq. ft. The maximum application rate on the product labels for application to hard surfaces is 0.126 lb ai/gal (see Table 4.1) for a residential setting and 0.0183 lb ai/gal (see Table 6.1) in an institutional setting (i.e. daycare center). Therefore, the application rates used in the postapplication scenarios were 0.000126 lb ai/ft^2 and 0.0000183 lb ai/ft^2.
- No transferable residue data were available that could be used to estimate the transfer of OPP and salts from the floor to skin. Therefore, it is assumed that 10% of the deposition rate is available for dermal transfer (USEPA, 2000, and 2001).
- No data could be found regarding the quantity of solution residue left on the floor after treatment. As a conservative measure, it has been assumed that 25% of the cleaner remains after the final mopping.
- It was assumed that the exposed toddler plays regularly on the treated floor. In a residential home, a short-term exposure duration is most likely since homeowners are expected to clean the floor only intermittently. In a commercial daycare center, an intermediate-term exposure duration is likely since it is expected that the floors are cleaned on a routine basis.

Results

The calculations of the short- and intermediate-term dermal doses and MOEs are shown in Table 4.4. The dermal MOEs for the residential settings (short-term MOE) and institutional settings (intermediate-term MOE) are above the target MOE of 100.

Table 4.4. Short- and Intermediate-term Post-application Dermal Exposures and MOEs for Children Contacting Treated Floors						
Exposure Scenario	Application Rate (lb ai/sq ft)	Product remaining after mopping	Percent Trans. Residue	Body Area in contact with floor (m^2)	Absorbed potential daily dose[a] (mg/kg/day)	Dermal MOE[b]
Hard surfaces - residential setting	$1.26x10^{-4}$	25%	10%	0.657	0.674	150 (ST)
Hard surfaces - daycare center	$1.83x10^{-5}$	25%	10%	0.657	0.0421	930 (IT)

a Absorbed Potential Daily Dose(mg/kg/day) = [(Application rate, lb ai/ft^2)*(conversion factor, 454 g/lb)* (conversion factor, 1,000 mg/g) * (conversion factor, 1 ft^2/0.093 m^2) * (product remaining after mopping, 25%) * (dermal transfer factor, 10%) * (body surface area in contact with floor, 0.657 m^2) * (dermal absorption , 0.43 for IT exposure and not applicable for ST exposures)] / (body weight, 15 kg)

b Dermal MOE = NOAEL (mg/kg/day) / Absorbed Potential Daily Dose (mg/kg/day) [Where short-term dermal NOAEL = 100 mg/kg/day and intermediate-term dermal NOAEL = 39 mg/kg/day]. Target MOE = 100.

Child Incidental Ingestion Exposure to Treated Floors

Exposure Calculations

In addition to dermal exposure, toddlers crawling on treated hard floors will also be exposed to OPP and OPP salts residues via incidental oral exposure through hand-to-mouth activity. To calculate incidental ingestion exposure to these chemicals due to hand-to-mouth transfer, the methodologies established in the *Standard Operating Procedures (SOPs) for Residential Exposure Assessments* (USEPA 2000 and, 2001) were used. These use assumptions that are similar to those used in calculating dermal exposures for toddlers crawling on treated hard floors. Exposures were calculated for children contacting treated floors in residential homes and in commercial day care centers using the following equations for hand-to-mouth transfer of pesticide residues to toddlers:

$$PDD = \frac{SR \times DTF \times SA \times EF \times ET \times SE \times CF1}{BW}$$

where:

PDD	=	Potential daily dose (mg/kg/day);
SR	=	Indoor surface residue (µg/cm^2);
DTF	=	Dermal transfer factor (unitless fraction);
SA	=	Surface area of the hands that contact both the treated area, and the individuals mouth (cm^2/event);
FQ	=	Frequency of hand-to-mouth events (events/hr);
SE	=	Saliva extraction efficiency (unitless fraction);
ET	=	Exposure Time (4 hrs/day);
CF1	=	Unit conversion factor (0.001 mg/µg); and
BW	=	Body weight (15 kg)

And

SR=AR x DRF x CF2 x CF3

where:

SR	=	Surface residue (µg/cm^2);
AR	=	Application rate (lb ai/ft^2);
DRF	=	Disinfection fraction remaining on floor (unitless);
CF2	=	Unit conversion factor ($4.54x10^8$ µg/lb); and
CF3	=	Unit conversion factor ($1.08x10^{-3}$ ft^2/cm^2)

Assumptions

- Toddlers (3 years old) were used to represent the 1 to 6 year old age group and are assumed to weigh 15 kg, the median for male and female toddlers (USEPA, 2000 and 2001).
- Based on HED's Residential SOP, it was assumed that the surface area used for each hand-to-mouth event is 20 cm^2. For short-term exposures, it is assumed that there were 20 events per hour (90^{th} percentile, according to the SOP) and for intermediate-term exposures, it was assumed that there were 9.5 event/hour (mean value).
- The exposure time was 4 hours a day (USEPA, 2000 and 2001).
- The saliva extraction efficiency was 50% (USEPA, 2000 and 2001).
- The labels did not provide information on the volume of disinfectant to be used for cleaning surfaces such as floors. It was assumed that the diluted treatment solution was applied at a rate of 1 gallon per 1,000 sq. ft. The maximum application rate on the product labels for application to hard surfaces is 0.126 lb ai/gal (see Table 4.1) for a residential setting and 0.0183 lb ai/gal (see Table 6.1) in an institutional setting (i.e. daycare center). Therefore, the application rates used in the postapplication scenarios were 0.000126 lb ai/ft^2 and 0.0000183 lb ai/ft^2.
- No data could be found regarding the quantity of solution residue left on the floor after treatment. As a conservative measure, it was assumed that 25% of the cleaner remains after the final mopping.
- No transferable residue data were available that could be used to estimate the transfer of OPP and salts from the floor to skin. Therefore, it was assumed that 10% of the deposition rate is available for dermal transfer (USEPA, 2000 and 2001).

Results

The calculation of the short- and intermediate-term oral doses and the oral MOEs are shown in Table 4.5. The oral MOEs are above the target MOE of 100 for residential settings and institutional settings.

For the intermediate-term exposures, it was necessary to determine Total MOEs since the toxicity effects are the same for the dermal and oral routes. The intermediate-term Total MOE for children contacting treated floors in day care facilities was 820 and is greater than the target MOE of 100. The Total MOE was estimated using the following equation: Total MOE = $1 / ((1/MOE_{dermal}) + (1/MOE_{oral}))$ where, MOE_{dermal} = 930 and MOE_{oral} = 6,900.

Table 4.5. Short- and Intermediate-term Incidental Oral Post-application Exposures and MOEs for Children Contacting Treated Floors

Exposure Scenario	Appl. Rate (lb ai/ sq ft)	Product remaining after mopping	Surface Residue[a] (µg/cm^2)	Percent transferable residue	Surface area mouthed (cm^2/event)	Exposure Frequency (events/hr)	Saliva Extraction Factor	Exp. Time (hrs/day)	Absorbed Potential Daily Dose[b] (mg/kg/day)	Oral MOE[c]
Hard surfaces - residential setting	$1.26x10^{-4}$	25%	15.45	10%	20	20	50%	4	0.0824	1,200 (ST)
Hard surfaces - daycare center	$1.83x10^{-5}$	25%	2.24	10%	20	9.5	50%	4	0.0057	6,900 (IT)

a Surface residue (µg/cm^2) = (application rate, lb ai/ft^2)*(Disinfectant fraction remaining on floor, 0.25)*(conversion factor to convert lb to µg, 4.54E+08 µg/lb)*(conversion factor to convert ft^2 to cm^2, 1.08E-03 ft^2/cm^2)

b Absorbed Potential Daily Dose (mg/kg/day) = [(Surface residue, µg/cm^2)*(transferable residue, 0.10)*(exposure time, 4 hrs/day)*(surface area of hands, 20 cm^2/event)*(frequency of hand-to-mouth activity, 20 events/hr, and 9.5 event for intermediate term)*(extraction by saliva, 50 %)*(conversion factor to convert µg to mg, 0.001 mg/µg)]/(body weight, 15 kg)

c MOE = NOAEL (mg/kg/day) / absorbed potential daily dose(mg/kg/day) [Where short-term oral NOAEL = 100 mg/kg/day and intermediate-term NOAEL = 39 mg/kg/day]. Target MOE = 100.

4.4.2.2 Textiles

Dermal Exposure to Adults and Children from Wearing Treated Clothing

Exposure Calculations

There is the potential for dermal exposure to adults and children from wearing clothing treated with a trigger-pump spray product containing OPP or treatment via factory impregnation of the chemical as a preservative. Even as there is anticipated exposure to result from an already preserved textile, the trigger-pump use was identified to be the worst case, and ultimately was the one assessed in this document. Though it is likely that the clothing treated with this product would be washed prior to use, the label does not provide specific use instructions pertaining to washing. Therefore, a post-application assessment assuming no laundering was conducted as a conservative measure. It should be noted that it was assumed that not all articles of clothing are treated with the OPP products or worn on a continuous basis therefore, only short-term duration exposures were assessed for the clothing scenarios.

Potential doses are calculated as follows:

$$PDD = \frac{C \times SA \times ET \times TR \times CF1}{BW}$$

where:

PDD = potential daily dose (mg/kg/day);
C = concentration on clothing (mg ai/cm^2);
SA = surface area of skin covered by clothing (cm^2/day);
ET = exposure time (hours/day);
TR = transferable residue from clothing to skin (%);
CF1 = conversion factor from hour to day (1 day/24 hours); and

BW = body weight (kg).

And

$C = A \times WF$

where:

C = Concentration on clothing (mg ai/cm^2)
A = Product absorption rate (198 mg/cm^2); and
WF = Weight fraction of product (% ai).

Assumptions

- There is one product labeled for use on clothing: #10088-00105 for trigger pump spray. The instructions state: "hold spray opening about 6 to 8 inches away from surface and spray until its [sic] thoroughly wetted. For proper disinfection, apply at approximately 20 °C, then allow 10 minutes for it to act". Because the label does not state otherwise, it was assumed that the clothing is to be worn after spraying, without any subsequent washing. Because no specific application rate information is available from the label, surrogate data were used. Whatman, Inc. sells "absorbent sinks", reels of absorbent materials for use in laboratories (Whatman, 2005). One of their products, CF7, is composed of 100% cotton and is 1.9 mm-thick. This product has a stated water absorption rate of 198 mg/cm^2. Since 1.9 mm seems a reasonable thickness for clothing, and the product label states that the clothing is to be thoroughly wetted, an application rate of 198 mg product/cm^2 was used for this assessment. Because the product contains 0.249% OPP, this corresponds to an application rate of 0.493 mg a.i./cm^2.
- The median surface area of clothing contacting skin for a 3-year-old toddler is 5,670 cm^2 (total body surface area minus the head) (USEPA, 1997a). For adults, the median surface area is 16,900 cm^2 (total body surface area minus the head) (USEPA, 1997a).
- No data were available from which a transfer factor could be estimated. Potential doses were calculated using a conservative transfer factor of 100%, which assumes that all residues are transferable from clothing surfaces to the skin. In cases where the MOEs did not meet the Agency's target MOE, potential doses were also calculated using a less conservative transfer factor of 5%, which is based on the amount of residue assumed to be transferable from carpeted surfaces (USEPA, 2000 and 2001). In these cases, confirmatory data are needed to support the use of the lower transfer factor.
- An exposure time of 16 hours has been used (waking hours).
- Toddlers (3 years old) are assumed to weigh 15 kg. This is the mean of the median values for male and female toddlers (USEPA, 1997). For adults, a body weight of 70 kg has been assumed.

Results

The calculations of the short-term dermal doses and MOEs for adults and children wearing treated clothing are shown in Table 4.6. The dermal MOEs for children are below the target MOE of 100 using the 100% transfer factor (MOE < 1) and using the 5% transfer

factor (MOE = 16). For adults, the dermal MOEs are also below the target MOE of 100 using both the 100% transfer factor (MOE = 1) and the 5% transfer factor (MOE = 25).

Dermal Exposure to Infants Wearing Treated Cloth Diapers

There is the potential for dermal exposure to infants wearing cloth diapers treated with a trigger-pump spray product containing OPP. Though it is likely that the diapers treated with this product would be washed prior to use, the label does not provide specific use instructions pertaining to washing. Therefore, a post-application assessment assuming no laundering was conducted as a conservative measure. Furthermore, since infants typically wear diapers on a continuous basis, short-, intermediate-, and long-term exposure durations were necessary to assess. The exposures were calculated using the following equations and assumptions:

$$PDD = \frac{C \times SA \times EF \times TR}{BW}$$

where:

PDD	=	potential daily dose (mg/kg/day);
C	=	concentration on clothing (mg ai/cm^2);
SA	=	surface area of skin covered by the diaper (cm^2/diaper);
EF	=	exposure frequency (diapers/day);
TR	=	transferable residue from diaper to skin (%);
BW	=	body weight (kg).

And

$$C = A \times WF$$

where:

C	=	Concentration on clothing (mg ai/cm^2)
A	=	Product absorption rate (198 mg/cm^2); and
WF	=	Weight fraction of product (% ai).

Assumptions

- The application rate of the product is 0.493 mg a.i./cm^2, which is based on the product containing 0.249% a.i. and the diaper having a product absorption rate of 198 mg product /cm^2 (see discussion above).
- The median surface area of the body area covered by a diaper is 462 cm^2/diaper. This was calculated for a <1 year old, assuming that a diaper covers 1/3 of the trunk area (professional judgment) and the trunk area is 35.7% of the body surface area (USEPA 1997a). The total body surface area was assumed to be 3,925 cm^2.
- It was assumed that a child < 1 year old wears 8 diapers per day (Professional judgment).
- Potential doses were calculated using a transfer factor of 100 and 5%.
- A child under 1 year old was assumed to weigh 10 kg.

Results

Table 4.6 shows the calculations of the short-, intermediate-, and long-term dermal doses and MOE for infants wearing treated cloth diapers. When using a transfer factor of 100% and 5%, all MOEs were below the target MOE of 100.

Table 4.6. Dermal Post-application Exposures and MOEs for Children and Adults Contacting Treated Textiles

% a.i.	Product absorption rate (mg/cm^2)	Conc. on clothing[a] (mg ai/cm^2)	Surface area covered by textile (cm^2/day)	Percent transferred	Exposure time	Potential daily dose[b] (mg/kg/day)		Dermal MOE[c]	
Short-Term Wearing Treated Clothing - Children									
0.249	198	0.493	5,670	100%	16 (hours/day)	124.24		**<1**	
				5%	16 (hours/day)	6.21		**16**	
Short-Term Wearing Treated Clothing – Adults									
0.249	198	0.493	16,900	100%	16 (hours/day)	79.34		**1**	
				5%	16 (hours/day)	3.97		**25**	
Wearing Treated Diapers - <1 year old									
0.249	198	0.493	462	100%	8 diapers/day	182.2 (ST)	78.35 (IT/LT)	**<1** (ST)	**<1** (IT/LT)
				5%	8 diapers/day	9.11 (ST)	3.92 (IT/LT)	**11** (ST)	**10** (IT/LT)

a Concentration on clothing (mg/cm^2) = % active ingredient / 100 * Product absorption rate (198 mg/cm^2)

b Potential Daily Dose for clothing (mg/kg/day) = [(concentration on clothing, mg/cm^2) * (surface area of skin covered by clothing, cm^2/day) * (percent transferable residue from textile) * (exposure time, hrs/day) * (conversion factor, 1 day/24 hours)] / (body weight, kg).
Potential Daily Dose for diapers (mg/kg/day) = [(concentration on diapers, mg/cm^2) * (surface area covered by diaper, cm^2/diaper) * (exposure frequency, diapers/day) * (dermal absorption factor, 0.43 for IT, not applicable for ST) * (percent transferable residue from diapers)] / (body weight, kg)

c MOE = NOAEL (mg/kg/day) / absorbed potential daily dose [Where short-term dermal NOAEL = 100 mg/kg/day and IT/LT dermal NOAEL = 39 mg/kg/day]. Target MOEs = 100.

Incidental Oral Exposure to Children Mouthing Treated Textiles

Exposure Calculations

There is the potential for incidental oral exposure to children from mouthing textiles treated with a trigger-pump spray product containing OPP.

Potential doses are calculated as follows:

$$PDD = \frac{C \times SA \times SE}{BW}$$

where:

PDD = potential daily dose (mg/kg/day)
C = concentration on clothing (mg/cm^2)
SE = saliva extraction efficiency (%)
SA = Surface area mouthed (cm^2/day)
BW = body weight (kg)

Assumptions

- The concentration of the chemical on clothing was determined using same methodology as discussed in the previous section, post-application dermal exposure to textiles.
- The surface area of textiles mouthed by children is 20 cm^2 (professional judgment).
- The saliva extraction efficiency is 50% (USEPA, 2000 and 2001).
- Toddlers (3 years old) are used to represent the 1 to 6 year old age group. For three-year olds, the median body weight is 15 kg (USEPA, 1997).

Results

Table 4.7 shows the calculation of the oral dose and oral MOE for children mouthing treated textiles. The MOE value is above the target MOE of 100 (MOE = 300).

Table 4.7. Short-term Post-application Incidental Oral Exposures and MOEs for Children Contacting Treated Textiles

% a.i.	Product absorption rate (mg/cm^2)	Concentration on clothing[a] (mg/cm^2)	Area mouthed (cm^2/day)	Saliva Extraction Factor	Potential daily dose (mg/kg/day)	Incidental Oral MOE[c]
0.249	198	0.493	20	50%	0.329	300

a Concentration on clothing (mg ai/cm^2) = % active ingredient * Product absorption rate (198 mg/cm^2)
b Potential Daily Dose (mg/kg/day) = (Concentration on clothing, mg/cm^2) * (area mouthed, cm^2/day) * (saliva extraction factor, unitless fraction) / (body weight, kg).
c MOE = NOAEL (mg/kg/day) / absorbed potential daily dose [Where short-term oral NOAEL = 100 mg/kg/day]. Target MOE = 100.

4.4.2.3 Plastics (Toys)

There is the potential for incidental oral exposure to children from mouthing plastic toys impregnated with products containing OPP and OPP salt preservatives.

Oral Exposure to Children from Mouthing Treated Plastic Toys

The exposure estimates for children mouthing treated toys are based on the methodology used for Microban Additive "B" assessment (USEPA 1997b), which assessed risks to 12 month old infants playing with treated toys, and exposure assumptions from HED's Residential SOPs (USEPA, 2000 and 2001).

Exposure Calculations

Potential doses are calculated as follows:

$$PDD = \frac{SR \times SE \times SA}{BW}$$

where:

PDD	=	potential daily dose (mg/kg/day);
SR	=	surface residue (mg/cm^2);
SE	=	saliva extraction efficiency (unitless fraction)
SA	=	surface area of toy mouthed (cm^2/day)
BW	=	body weight of a 12 month old infant (kg).

And

$$SR = \frac{\% \text{ a.i} \times W \times CF \times F}{SA}$$

where:

SR	=	surface residue (mg a.i./cm^2)
% a.i.	=	fraction active ingredient in toy by total weight (unitless)
W	=	weight of toy (g)
CF	=	conversion factor (1,000 mg/g)
F	=	fraction additive available at the surface of the toy (unitless)
SA	=	surface area of toy (cm^2)

Assumptions

- Since chemical specific leaching data were not available, the actual amount of active ingredient at the surface of the toy which is available for mouthing is based on the following assumptions:
    - the toy is manufactured from ABS or polystyrene plastic;
    - the diffusion of the active ingredient available at the surface of the toy to the child's mouth is allowed to reach equilibrium; and
    - no more then 0.5% of the additive is available on the surface of the toy for each mouthing event.
- The total surface area of a treated toy is 500 cm^2 (Dang 1997).
- The weight of a 500 cm^2 toy is 50 g, which is based on data that show a polyethylene highchair sample with a surface area of 12.7 cm^2 weighs 1.3072 g (i.e., 0.1 g/cm^2) (Dang, 1997).
- 50% of the surface residue is ingested (saliva extraction efficiency).
- The body weight of a 12 month old infant is 10 kg.
- A child mouths 500 cm^2 of treated toy surface per day.

Results

Table 4.8 presents the calculations of the oral dose and MOE for children mouthing treated toys. The MOE value is above the target MOE of 100 (MOE = 2400).

Table 4.8 Short-term Post-application Incidental Oral Exposures and MOEs for Infants Mouthing Treated Toys

% ai	Weight of toy (g)	Percent additive available at surface of the toy (%)	Surface area of toy (cm^2)	Surface Residue [a] (mg ai/cm^2)	Saliva Extraction Factor	Surface area of toy mouthed (cm^2/day)	Absorbed potential Daily Dose [b] (mg/kg/day)	Incidental Oral MOE [c]
0.34%	50	0.5%	500	0.0017	50%	500	0.0425	2400

a Surface Reside (mg ai for a 500 cm^2 toy) = (% ai) * (Weight of toy, 50 g) * (Conversion factor, 1000 mg/g) * (Additive available at surface of toy, 0.5%) / (Surface area of toy, 500 cm^2)

b Potential Daily Dose (mg/kg/day) = Surface residue (0.0017 mg ai/cm^2) * (toy area mouthed, 500 cm2/day) * (saliva extraction) /(body weight, 15 kg)

c MOE = NOAEL (mg/kg/day) / potential daily dose (mg/kg/day) [Where short-term oral NOAEL = 100 mg/kg/day]. Target MOE = 100.

4.4.2.4 Air Deodorizers

No post-application air concentration data have been submitted for OPP products to determine potential vapor inhalation risk. Therefore, the Multi-Chamber Concentration and Exposure Model (MCCEM v1.2) was used to present a screening-level estimate of the potential inhalation risk to adults and children. MCCEM estimates average and peak indoor air concentrations of chemicals released from products or materials in houses, apartments, townhouses, or other residences. The data libraries in MCCEM contain information about residential settings. MCCEM estimates inhalation exposures to chemicals, calculated as single day doses, chronic average daily doses, or lifetime average daily doses. It should be noted that all dose estimates are potential doses; they do not account for actual absorption into the body.

Assumptions

- The area being deodorized is a bedroom in a generic house. The product is deployed just before bedtime (i.e., 8-hr exposure while sleeping).
- Deodorization occurs instantaneously, so that the entire mass of product is mixed homogeneously with the indoor air as soon the product is deployed. It was assumed that 100% of the product is available as inhalable vapor.
- The label for product #44446-67 states that one can (168 g, 0.199% OPP) can be used to deodorize one 6,000 ft^3 (170 m^3) area for 30 days. Based on this rate of use, the amount used in one bedroom (35 m^3 in the MCCEM generic house) per day is assumed to be 1.15 g (168 g x 35 m^3 / 170 m^3 / 30 days).
- The product #44446-67 can be used in both residential and institutional settings (i.e., day care facilities). Therefore, short-term duration exposures were assessed for adults and children in residential settings since this type of product was assumed to be used on an intermittent basis. However, short- and intermediate-term duration exposures were assessed for children in day care facilities since this type of product was assumed to be used on a routine basis.

Results

Details of the MCCEM modeling can be found in Appendix B. Results of the MCCEM calculation are shown in Table 4.9. For both adults and children, the calculated inhalation MOEs are greater than the target MOE of 100. Furthermore, these MOEs are also greater than 1,000 therefore; an additional inhalation toxicity study is **not** warranted based on the results of this scenario.

Table 4.9. Short- and Intermediate-Term Post-application Inhalation Exposures and MOEs for Adults and Children in Areas Treated with Air Deodorizers

Parameter	Value		Rationale
	Adult	Child	
House*	Generic House (2-chambers: 35 m^3 bedroom, 373 m^3 other rooms)		MCCEM default
Activity Schedule*	In bedroom at start of modeling, out after 8 hours		EPA Assumption
Concentration of product	0.199% OPP by weight		Product label #44446-67
Quantity in Can	168 g product		Product label #44446-67
Quantity Used per Day	1.15 g product ($2.54x10^{-3}$ lb product)		Based on rate of 1 can per 6,000 m^3 for 30 days, and a bedroom size of 35 m^3
Quantity ai Used per Day	$5.06x10^{-6}$ lb ai/day ($2.30x10^{-3}$ g/day)		(Quantity per day) * (Concentration)
Concentration in Bedroom after spraying (Initial Concentration in Bedroom)*	$6.56x10^{-5}$ g a.i./m^3 (65.6 µg a.i./m^3)		(Quantity ai per day) / (Bedroom volume)
Body Weight*	70 kg	15 kg	Average body weights for adults and young children
Inhalation Rate*	11.6 m^3/day	8.88 m^3/day	Average resting rate for adults and young children (USEPA, 1997)
MCCEM Outputs			
Dose	$2.67x10^{-4}$ mg/kg/day	$9.53x10^{-4}$ mg/kg/day	MCCEM Output
Inhalation short-term MOE	370,000	100,000	NOAEL (100 mg/kg/day)/Dose
Inhalation intermediate-term MOE (day care facilities)	NA	41,000	NOAEL (39 mg/kg/day)/Dose

*Used as MCCEM input. Default values from MCCEM were used for all inputs not listed in the table above.

4.4.2.5 Paints

AD utilized EPA's Wall Paint Exposure Model (WPEM) version 3.2 to estimate air concentrations resulting from the use of paint preserved with OPP. For this exposure assessment, a WPEM default scenarios were used to determine exposure to adults (RESADULT) and children (RESCHILD). In these scenarios, an adult and child are located in a non-painted part of the house while a bedroom is being painted by a professional painter. For a detailed description of the RESADULT and RESCHILD scenarios, see the WPEM User's Guide. The following chemical-specific inputs were used in the model:

- OPP's molecular weight (170.19 amu) and vapor pressure (0.002 mm Hg)
- The weight fraction of OPP in paint (product #464-126 contains 0.5% OPP)

The model provides several dose measures (i.e., LADD, ADD), air concentration measures (i.e., peak, 15-min, 8hr), and a comma-separated (.csv) file as outputs. The comma-separated file contains details on time-varying concentrations within the modeled building as well as concentrations to which the individual is exposed. This file can be read directly into spreadsheet software (e.g., Excel) for calculating additional summary statistics. The air concentrations outputted by the model were used by AD to estimate inhalation exposure doses and MOEs. The model results and exposure calculations are summarized in Table 4.10. It should be noted that the WPEM model moves the occupant throughout the home (i.e., zone 1 = painted room, zone 2 = non-painted room, and outdoors) based on predefined activity schedules. Therefore, the 24-hr average used in this assessment was based on OPP air concentrations found in each zone at the specific time the person is placed within the associated zone (see Appendix E). Furthermore, although the house dimensions and the painting schedule is identical for both the adult and child scenario, the average air concentrations to which the individuals are exposed are different, due to different schedules of activities followed by the adult and child.

Table 4.10. Short-term Post-application Inhalation (vapor) Exposures and MOEs for Adult and Children in Areas Painted with Preserved Paint

Exposed Individual	24-hr TWA (mg/m^3)[a]	Exposure Duration (hrs/day)	Inhal. Rate (m^3/hr)[b]	Inhalation Dose (mg/kg/day)[c]	ST Inhal. MOE[d]
Adult	0.98	24	0.5	0.168	600
Child	1.35	24	0.4	0.867	120

[a] 24-hr Time Weighted Average (TWA) including the time during and after painting occurs (see Appendix E)
[b] Inhalation rate for sedentary activity as indicated in the Exposure Factors Handbook (USEPA, 1997)
[c] Inhalation Dose = Air Conc. TWA * Exposure duration * Inhalation Rate / Body Weight (70 kg for adults, 15 kg for children)
[d] Short-Term Inhalation MOE = Short-Term Inhalation NOAEL (100 mg/kg/day) / Inhal. Dose

Both the child and adult inhalation MOEs are above the target MOE of 100, but below a value of 1,000. Since the MOEs are below 1,000, the Agency may request that a confirmatory inhalation toxicity study be conducted.

4.4.2.6 Foggers

Post-application inhalation exposures were assessed for entry into a room after a fogging application was conducted using MCCEM v1.2.

One product was identified that can be used for fogging in residential settings (product #70263-3, 0.22% OPP, 0.0183 lbs a.i./gal). The label states that the product is for household use in areas damaged by smoke, fire, floods, and sewage backups and also notes that the product can be applied with appropriate fogging equipment. Therefore it was assumed that a professional cleanup operation would actually apply the product in a residential setting, such as a basement. No other information was provided on the label regarding use of the product as a fogger. In the absence of better information, an assessment was performed for residential post-application exposures using the OPP concentration from label #70263-3 (0.0183 lb ai/gal) and the application rate listed on product #65020-7 (1 gallon of product per 6,000 square feet). Note that product #65020-7 is intended for fogging agricultural premises and was selected for occupational assessment. Because the label for product #70263-3 did not provide a re-entry interval, this assessment was performed using reasonable re-entry intervals (REIs) of 0 and 4 hours. Concentrations of exposed individuals were determined for 2, 8, and 24 hours of exposure. It should be noted that label #70263-3 can be used in both residential and institutional settings (i.e., day care facilities). However, since this product (when used as a fogger) appears to be used specifically for clean up following smoke, fire, floods, and sewage backup damage, it was assumed that it would not be used on a routine basis and only short-term duration exposures would occur in both the residential and institutional setting.

Assumptions

- The area being fogged is the default 1-chamber generic house (assuming this is similar to a water-damaged basement), as defined by MCCEM (408 m^3, ACH=0.18/hr).
- Fogging occurs instantaneously, so that the entire mass of product is mixed homogeneously with the indoor air as soon as fogging commences.
- Table 4.11 summarizes the model inputs

Table 4.11. MCCEM Model Inputs for Postapplication Exposure to Fogged Houses

Parameter	Value		Rationale
	Adult	Child	
House Dimensions*	408 m^3 (14,400 ft^3) 1801 ft^2 floor area		MCCEM 1-chamber generic house, assuming 8-ft high stories
Concentration of Fogging Liquid	0.22% a.i. (OPP) 0.0183 lbs a.i./gal		See Table 6.1.
Use rate	1 gal/6000 ft^2		Product label #65020-7
Mass applied to house	0.00549 lbs a.i. (2.49 g a.i.)		(Use rate) x (Concentration) x (Floor area)
Concentration in house after fogging (initial concentration at time 0)*	0.00611 g/m^3		Mass / Volume

Body Weight*	70 kg	15 kg	Average body weights for adults and young children
Light Activity Inhalation Rate (m^3/hr)*	0.5	0.4	Sedentary activity inhalation rates for adults and young children (USEPA, 1997a)

*Used as MCCEM input. Default values from MCCEM were used for all inputs not listed in the table above.

Results

Details of the MCCEM modeling can be found in Appendix B. Based on the model output, inhalation exposures to adults and young children were calculated (Table 4.12). All of the adult and child inhalation MOEs were above the target MOE of 100. All of the MOEs for children were below 1,000. However, the ST vapor inhalation exposures to adults for a 0-hr REI and a 4- and 24- hour exposure duration along with the ST vapor inhalation exposure to adults for a 4-hr REI and 24 hour exposure duration were below 1,000. Therefore, the based on the results of these scenarios for which the calculated MOEs are below 1,000, the Agency may request that a confirmatory inhalation toxicity study be conducted.

Table 4.12. Short-term Post-application Inhalation Exposures and MOEs for Adults and Children in Fogged Houses

Re-Entry Interval (hrs)	Exposure Duration (hrs/day)	TWA Air Conc. (mg/m^3)[a]	Inhalation Rate (m^3/hr)[b]	Inhalation Dose (mg/kg/day)[c]	ST Inhal. MOE[d]
Adults					
0	2	5.25	0.5	0.075	1,300
	4	4.45	0.5	0.127	790
	24	1.43	0.5	0.245	410
4	2	2.56	0.5	0.037	2,700
	4	2.17	0.5	0.062	1,600
	24	0.695	0.5	0.119	840
Child					
0	2	5.25	0.4	0.280	360
	4	4.45	0.4	0.475	210
	24	1.43	0.4	0.914	110
4	2	2.56	0.4	0.136	730
	4	2.17	0.4	0.231	430
	24	0.695	0.4	0.445	230

[a] Air concentrations calculated by MCCEM using inputs described in Table 4.11. Model provided air concentrations at 15-minute intervals. Starting after the REI, the TWA was calculated for each exposure time duration (See Appendix B).
[b] Inhalation rate is based on sedentary activity of adults and young children (USEPA, 1997a)
[c] Inhalation Dose = Exposure Duration x TWA x Inhalation Rate / Body Weight (70 kg for adults, 15 kg for children)
[d] Short-Term Inhalation MOE = Short-Term Inhalation NOAEL (100 mg/kg/day) / Inhal. Dose

4.4.3 Data Limitations/Uncertainties

There are several data limitations and uncertainties associated with the residential handler and postapplication exposure assessments which include the following:

- Surrogate dermal and inhalation unit exposure values were taken from the proprietary Chemical Manufacturers Association (CMA) antimicrobial exposure study (USEPA, 1999: DP Barcode D247642) or from the Pesticide Handler Exposure Database (USEPA, 1998) (See Appendix A for summaries of these data sources). Most of the CMA data are of poor quality therefore, AD requests that confirmatory monitoring data be generated to support the values used in these assessments.
- The quantities handled/treated were estimated based on information from various sources, including HED's Standard Operating Procedures (SOPs) for Residential Exposure Assessments (USEPA 2000, and 2001) and AD standard assumptions, which can be further refined from input from registrants.
- The low pressure spray unit exposure data from PHED were used to assess outdoor applications to hard surfaces (exterior of homes). As the low pressure spray data are representative of treating low to mid level shrubs and the scenario assessed in this document represents treatments above the waist, the unit exposure value may underestimate exposure to the head and the upper body.
- The method used to estimate exposure from mouthing treated plastic toys is conservative because it does not account for washing of the toy or depletion of residue after each toy-to-mouth episode.
- The textile exposure methods were very conservative because they assumed that the textiles were saturated with the product, dried, and worn. No laundering was accounted for because the labels did not provide specific use instructions pertaining to washing of the clothing/diapers.
- A confirmatory study is needed to verify the 5% transfer factor for clothing and diapers.
- The Wall Paint Exposure Model is designed to estimate indoor-air concentrations and associated inhalation exposures for interior applications involving alkyd or latex primer/paint. The chamber tests on which the emission algorithms are based involve a limited set of chemicals with a correspondingly limited range of properties (molecular weight and vapor pressure). Further, the emission algorithms are valid only for chemicals that are formulated into alkyd/latex primers or paints. Actual monitoring data could be used to refine the exposures and risks estimated in this assessment.

5.0 RESIDENTIAL AGGREGATE RISK ASSESSMENT AND CHARACTERIZATION

5.1 Acute and Chronic Dietary Aggregate Risk

This is included in the Preliminary Risk Assessment.

5.2 Short and Intermediate Term Aggregate Risk

In order for a pesticide registration to continue, it must be shown "that there is reasonable certainty that no harm will result from aggregate exposure to pesticide chemical

residue, including all anticipated dietary exposures and other exposures for which there are reliable information." Aggregate exposure is the total exposure to a single chemical (or its residues) that may occur from dietary (i.e., food and drinking water), residential, and other non-occupational sources, and from all known or plausible exposure routes (oral, dermal, and inhalation). However, this assessment only addresses non-dietary residential aggregate exposures and risks. The PRA of the RED will address the complete aggregate assessment including both dietary and non-dietary residential exposures and risks.

In performing aggregate exposure and risk assessments, the Office of Pesticide Programs has published guidance outlining the necessary steps to perform such assessments (General Principles for Performing Aggregate Exposure and Risk Assessments, November 28, 2001; available at http://www.epa.gov/pesticides/trac/science/aggregate.pdf). Steps for deciding whether to perform aggregate exposure and risk assessments are listed, which include: identification of toxicological endpoints for each exposure route and duration; identification of potential exposures for each pathway (food, water, and/or residential); reconciliation of durations and pathways of exposure with durations and pathways of health effects; determination of which possible residential exposure scenarios are likely to occur together within a given time frame; determination of magnitude and duration of exposure for all exposure combinations; determination of the appropriate technique (deterministic or probabilistic) for exposure assessment; and determination of the appropriate risk metric to estimate aggregate risk

Short- and Intermediate-Term Aggregate Exposures and Risks

Short- and intermediate-term aggregate exposures and risks were assessed for adults and children that could be exposed to OPP and OPP salt residues from the use of products in non-occupational environments. The following lists summarize all of the non-dietary, non-occupation potential sources of OPP and OPP salt exposures for adults and children:

Adult OPP and OPP salt exposures sources:
- Cleaning indoor hard surfaces via mopping, wiping, or spraying
- Cleaning outdoor hard surfaces via low pressure sprayer
- Applying textile products to clothes and diapers
- Applying air deodorizers in residential settings
- Applying of OPP preserved paint in residential settings
- Wearing treated clothing
- Post-application exposure to OPP vapors from foggers used in residential settings
- Post-application exposure to OPP vapors from air deodorizers used in residential settings
- Post-application exposure to OPP vapors from OPP preserved paint used in residential settings

Child OPP and OPP salt exposures sources:
- Post-application exposures to residues from cleaning products used on hard surfaces (i.e., floors)
- Wearing treated clothing and diapers
- Post-application exposure to OPP vapors from foggers used in residential settings
- Post-application exposure to OPP vapors from air deodorizers used in residential settings

- Post-application exposure to OPP vapors from OPP preserved paint used in residential settings
- Playing with OPP preserved plastic toys

The use patterns of the products and probability of co-occurrence must be considered when selecting scenarios for incorporation in the aggregate assessment. In the case of OPP and OPP salts, homeowner painting activities occur only once or twice a year. Furthermore, the use of fogger products occurs on an intermittent basis since they are used as a cleanup after water or smoke damage. Therefore the probability of co-occurrence and the potential for exposure to residues from these products on the same day is highly unlikely. However, it is likely that someone could clean the kitchen (mopping and wiping activities) as well as, use an air deodorizer containing OPP or OPP salts during the same day.

Cleaning activities in a residential setting occur on a short-term basis. However, the OPP and salts-containing cleaning products are also labeled for use in institutional settings such as day care facilities where cleaning activities can occur on an intermediate-term basis. Therefore, children could have exposure to cleaning product residues on a more continuous basis in a day care facility thus; these post-application scenarios were included in the intermediate-term aggregate assessment. Table 5.1 summarizes the scenarios included in the short- and intermediate-term aggregate assessments.

Table 5.1: Summary of Exposure Scenarios Included in the Short- and Intermediate-Term Aggregate Assessments

	Short-term Aggregate	Intermediate-Term Aggregate
Adults	Dermal: • Mopping applicator • Wiping applicator • Air deodorizer applicator	Dermal + Oral + Inhalation: • No applicable exposures
	Oral + Inhalation: • Mopping applicator • Wiping applicator • Air deodorizer applicator • Post-app to air deodorizers	
Children	Dermal: • Dermal post-app exposure to residues from mopping activities	Dermal + Oral + Inhalation: • Inhalation post-app exposure to air deodorizer residues • Oral post-app exposure to residues from mopping activities • Dermal post-app exposure to residues from mopping activities
	Oral + Inhalation: • Inhalation post-app exposure to air deodorizer residues • Oral post-app exposure to residues from mopping activities	

It should be reiterated that the adult and child dermal post-application exposures to textile OPP residues alone are of concern to the Agency. Incorporation of this scenario in the aggregate assessment would result in risks of concern. Therefore, the textile scenario was not incorporated in the aggregate assessment. If these exposures did not result in risks of

concern, then they also would have been included in the aggregate assessments. It should also be noted that the short-term aggregate assessment for children did not include a child mouthing plastic toys because this scenario is represented by children under the age of 1 year old whereas, the child aggregate assessment is represented by children 3 years old.

Since the short-term dermal toxicity endpoint was based on skin irritation and the oral and inhalation endpoints were based on the same study and toxic effect, the short-term dermal exposures were aggregated in a separate analysis from the short-term inhalation and oral exposures. However, the intermediate-term toxicity endpoints for all of the routes of exposure (oral, dermal and inhalation) are based on the same study and same toxic effect therefore, all intermediate-term routes were aggregated together. The Total MOE method outlined in OPP guidance for aggregate risk assessment (September 1, 2000, Standard Operating Procedure (SOP) for Incorporating Screening Level Estimates of Drinking Water Exposure into Aggregate Risk Assessments) was utilized in the assessment. This method was used because the oral, dermal and inhalation endpoints have the same uncertainty factors or target MOEs. The target MOE for all routes of exposure is 100. The general equation used to estimate total or aggregate MOEs is:

Aggregate MOE = 1 / ((1/MOEroute 1, scenario 1) + (1/ MOEroute1, scenario 2) + (1/MOE route 1, scenario n) + (1/MOEroute 2, scenario 1) + (1/MOEroute 2, scenario 2) + (1/MOEroute 2, scenario n) + (1/MOEroute n, scenario n))

Where, route represents oral, dermal, or inhalation exposures, and scenario represents handler or post-app wiping, mopping, etc.

Tables 5.2, 5.3, and 5.4 present the OPP short-term dermal exposures, the OPP short-term oral and inhalation exposures, and the OPP intermediate-term exposures used in the aggregate assessment, respectively. Tables 5.5, 5.6, and 5.7 present the resulting MOEs for the short-term dermal, short-term oral and inhalation, and intermediate term aggregate assessments, respectively. All of the short- and intermediate-term aggregate MOEs for residential scenarios were above the target MOE of 100.

Table 5.2: Exposures for Short-term Dermal Aggregate Assessment

Exposure Routes	Household Cleaning (mg/kg/day)				
	Applicator			Post-Application	
	Wipe	Mop	Air Deodorizers	Mop	Air Deodorizers
Adult					
Dermal	0.672	0.129	0.0064	NA	NA
Child					
Dermal	NA	NA	NA	0.674	NA

Table 5.3: Exposures for Short-term Oral and Inhalation Aggregate Assessment

Exposure Routes	Household Cleaning (mg/kg/day)				
	Applicator			Post-Application	
	Wipe	Mop	Air Deodorizers	Mop	Air Deodorizers
Adult					
Oral	NA	NA	NA	NA	NA
Inhalation	0.0157	0.0043	0.0001	NA	2.67E-04
Child					
Oral	NA	NA	NA	0.0824	NA
Inhalation	NA	NA	NA	NA	9.5E-04

Table 5.4: Exposures for Intermediate-term Aggregate Assessment

Exposure Routes	Household Cleaning (mg/kg/day)	
	Post-application	
	Mop	Air Deodorizers
Child		
Oral	0.0057	NA
Inhalation	NA	9.5E-04
Dermal	0.0421	NA

Table 5.5 Short-term Dermal Aggregate Risks

Exposure Routes	Household Cleaning MOEs					
	Applicator			Post-App		Aggregate
	Wipe	Mop	Air Deodorizers	Mop	Air Deodorizers	
Adult						
Dermal	150	780	16,000	NA	NA	120 [a]
Child						
Dermal	NA	NA	NA	150	NA	150

a: Aggregate MOE = 1/((1/MOEwipe) + (1/MOEmop) + (1/MOEair deodorizer))

Table 5.6: Short-term Oral and Inhalation Aggregate Risks

Exposure Routes	Household Cleaning MOEs					
	Applicator			Post-App		Aggregate
	Wipe	Mop	Air Deodorizers	Mop	Air Deodorizers	
Adult						
Oral	NA	NA	NA	NA	NA	4900[a]
Inhalation	6,300	23,000	670,000	NA	370,000	
Child						
Oral	NA	NA	NA	1,200	NA	1200[b]
Inhalation	NA	NA	NA	NA	100,000	

a: Aggregate MOE = 1/((1/MOEwipe, app-inhal) + (1/MOEmop,app-inhal) + (1/MOEair deodorizer, app-inhal) + (1/MOEair deodorizer, post-inhal))
b: Aggregate MOE = 1/((1/MOEmop, post-oral) + (1/MOEair deodorizer, post-inhal))

Table 5.7: Intermediate-term Aggregate Risks

Exposure Routes	Household Cleaning MOEs		
	Post-application		Aggregate
	Mop	Air Deodorizers	
Child			
Oral	6,800	NA	800[a]
Inhalation	NA	41,000	
Dermal	930	NA	

a: Aggregate MOE = 1/((1/MOEmop-oral) + (1/MOEmop-dermal) + (1/MOEair deodorizer-inhal))

6.0 OCCUPATIONAL EXPOSURE ASSESSMENT

The exposure scenarios assessed in this document for the representative uses selected by AD are shown in Table 6.1. The table also shows the maximum application rate associated with the representative use and the appropriate EPA Registration number for the product label. For handlers, the representative uses assessed include application to indoor hard surfaces, outdoor hard surfaces, and air deodorization (aerosol spray). Additionally, handler exposures were assessed for the application of treated paint (paint brush/roller and airless sprayer) and mixing and loading of product for fogging applications (liquid pour of soluble concentrate). It should be noted that for the calculation of application rates in which 8.34 lb a.i./gal is noted, the product is assumed to have the density of water because no product-specific density is available.

Potential occupational handler exposure can occur in various use sites, which include; agricultural premises, food handling premises, commercial/institutional/industrial premises, and medical premises. Additionally, occupational exposure can occur during the preservation of materials that are used for household, institutional, and industrial uses, along with the preservation of wood. The “preservation of materials” refers to the scenario of a worker adding the preservative to the material being treated (metalworking fluid, paint, textiles, etc.) through either liquid pour or liquid pump methods. Liquid pour refers to transferring the antimicrobial product from a small container to an open vat. Liquid pump refers to transferring the preservative by connecting/disconnecting a chemical metering pump from a tote or by gravity flow. For the preservation of wood, the procedure for treatment can occur in different ways, such that multiple worker functions were analyzed. Due to the complexity of the wood preservative analysis, the results for handler and postapplication exposures are presented in a separate section, 6.4.

Table 6.1. Representative Exposure Scenarios Associated with Occupational Exposures to OPP and OPP Salts

Representative Use	Method of Application	Exposure Scenario	Registration #	Application Rate
Agricultural Premises and Equipment				
Indoor Hard Surfaces	• Low pressure handwand • High Pressure Spray • Mopping • Wiping surfaces • Trigger pump spray	IT and ST Handler: dermal and inhalation	70263-3 (OPP)	0.0183 lb a.i./gal (0.22% a.i. x 8.34 lb/gal)
Fogger[1]	• Liquid pour of soluble concentrate	IT and ST Handler (mixer/loader only): dermal and inhalation ST Postapp: inhalation (vapor)	65020-7 (OPP)	0.661 lb a.i./ 6000ft^2 (7.92% a.i. x 1 gal product/6000 ft^2 x 8.34 lb/gal)
Food Handling				
Indoor Hard Surfaces	• Low pressure handwand • Mopping • Wiping surfaces[2]	IT and ST Handler: dermal and inhalation	11725-7 (OPP)	0.00391 lb a.i./gal (12.0% a.i. x 0.5 oz product/gal water x 8.34 lb/gal x 1gal/128oz)
	• Trigger pump spray[3]	IT and ST Handler: dermal and inhalation	69658-3 (OPP)	0.0334 lb a.i./gal (0.4% a.i. x 8.34 lb/gal)
Commercial/Institutional Premises				
Indoor Hard Surfaces	• Low pressure handwand	IT and ST Handler: dermal and inhalation	70263-3 (OPP)	0.0183 lb a.i./gal (0.22% a.i. x 8.34 lb/gal)
	• Mopping • Wiping surfaces[2]	IT and ST Handler: dermal and inhalation	40510-5 (OPP Salt)[7]	0.126 lb a.i./gal (8oz. product/4 gal water x 97% a.i. x 8.34 lb/gal x 1 gal/128 oz)
	• Trigger pump spray[3]	IT and ST Handler: dermal and inhalation	69658-3 (OPP)	0.0334 lb a.i./gal (0.4% a.i. x 8.34 lb/gal)
Outdoor hard surfaces	• Airless sprayer	IT and ST Handler: dermal and inhalation IT and ST	71240-1 (OPP Salt)	0.00104 lb a.i./gal (0.25% a.i. x 1 quart of product / 5 gal water x 1gal/4 quarts x 8.34 lb/gal)

Table 6.1. Representative Exposure Scenarios Associated with Occupational Exposures to OPP and OPP Salts

Representative Use	Method of Application	Exposure Scenario	Registration #	Application Rate
		Mixer/Loader		
Air Deodorization	• Aerosol spray	IT and ST Handler: dermal and inhalation	44446-67 (OPP)	0.199% a.i. by weight
Medical Premises				
Indoor Hard Surfaces	• Low pressure handwand	IT and ST Handler: dermal and inhalation	70263-3 (OPP)	0.0183 lb a.i./gal (0.22% a.i. x 8.34 lb/gal)
	• Mopping • Wiping surfaces[2]	IT and ST Handler: dermal and inhalation	46851-11 (OPP)	0.0234 lb a.i./gal (9% a.i. x 1/32 water dilution x 8.34 lb/gal)
	• Trigger pump spray	IT and ST Handler: dermal and inhalation	69658-3 (OPP)	0.0334 lb a.i./gal (0.4% a.i. x 8.34 lb/gal)
Air Deodorization	• Aerosol spray	IT and ST Handler: dermal and inhalation	44446-67 (OPP)	0.199% a.i. by weight
Material Preservatives				
Metalworking fluid (worker pouring preservative into fluid being treated)	• Liquid pour • Liquid pump	IT and ST Handler: dermal and inhalation	67869-24 (OPP salt)	5.66% a.i. by weight of the material to be treated (28.3% product by weight of material treated x 20% a.i. in product)[4]
		ST and IT/LT Machinist: dermal and inhalation (vapor)	464-126 (OPP)	1.5% a.i. by weight of the material to be treated (1.5% product by weight of material treated x 99.5% a.i. in product)
Paint	<u>Preservation of paint</u> • Liquid pour • Liquid pump	IT and ST Handler: dermal and inhalation	67869-24 (OPP Salt)	0.56% a.i. by weight of the material to be treated (2.8% product by weight of material treated x 20% a.i. in product)
	<u>Professional painter</u> • Brush/Roller • Airless sprayer	ST Prof Painter: dermal and inhalation (aerosol and vapor)	464-126 (OPP)	0.5% a.i. by weight of the material to be treated (0.5% product by weight of material treated x 99.5% a.i. in product)[5]

Table 6.1. Representative Exposure Scenarios Associated with Occupational Exposures to OPP and OPP Salts

Representative Use	Method of Application	Exposure Scenario	Registration #	Application Rate
Paper pulp	• Liquid pump	IT and ST Handler: dermal and inhalation	67869-24 (OPP Salt)	0.34% a.i. by weight of the material to be treated (1.7% product by weight of material treated x 20% a.i. in product)
Textiles	• Liquid pour • Liquid pump	IT and ST Handler: dermal and inhalation	67869-24 (OPP salt)	5.66% a.i. by weight of the material to be treated (28.3% product by weight of material treated x 20% a.i. in product)
		ST and IT Industrial bystander: inhalation[6] (vapor)	464-126 (OPP)	5% a.i. by weight of the material to be treated (5 % product by weight of material treated x 99.5% a.i. in product)
Wood Preservative (non-pressure treated)	• Airless Spray • Dip	IT and ST Handler: dermal and inhalation	67869-24 (OPP salt)	4.52% a.i. in treatment solution (formulated product is applied at a rate of 22.6% of the weight of the wood treated, and the product contains 20% a.i.)

[1] Label for fogging application in Food Handling, Commercial/Institutional, and Medical Premises (EPA Reg No. 11725-7) does not provide specific use rate instructions. Therefore the Agricultural Premise fogging scenario represents all fogging scenarios (EPA Reg No. 65020-7).
[2] Wiping surfaces is assumed to be representative of impregnated wipes.
[3] The trigger pump scenario also represents the aerosol scenario since the application rate for the trigger pump is higher and the aerosol spray. Also, the unit exposure for aerosol applications is used in the exposure assessment for both the trigger pump and aerosol spray products.
[4] Label 67869-24 provides a high application rate for preserving concentrate mineral oil-based cooling fluid products; therefore this label was assessed for the handler (adding the preservative to the concentrated cooling fluid). However, the label that provides an application rate for the non-concentrate fluid was selected for the machinist scenario (Label 464-126).
[5] For the professional painter and industrial bystander, the OPP product (Label 464-126) was assessed over the OPP salt product (Label 67869-24) because the vapor pressure of OPP is greater and therefore poses a greater inhalation risk.
[6] Currently, there is no data for the assessment of industrial bystanders' inhalation exposures.
[7] This label, # 40510-5, states that the product can be used for "housekeeping santization" and to "sanitize latrine: buckets, urinals, toilet bowls, walls, shower stalls, garbage cans, and garbage platforms." This is why it is assumed not to be used in daycares. It does not specifically say "commercial and institutional premises."

6.1 Occupational Handler Exposures

The occupational handler scenarios included in Table 6.1 were assessed to determine dermal and inhalation exposures. The general assumptions and equations that were used to calculate occupational handler risks are provided in Section 1.2, Criteria for Conducting the Risk Assessment. The majority of the scenarios were assessed using CMA data and Equations

1-3. However, for the occupational scenarios in which CMA data were insufficient, other data and methods were applied.

Unit Exposure Values (UE): Dermal unit exposure values were taken from the proprietary Chemical Manufacturers Association (CMA) antimicrobial exposure study (USEPA, 1999: DP Barcode D247642) or from the Pesticide Handler Exposure Database (USEPA, 1998).

- For the ***low pressure handwand*** scenarios, the CMA dermal and inhalation unit exposure values for ungloved use of a low pressure spray were used (191 mg/lb a.i. and 0.681 mg/lb a.i., respectively). These values are based on data collected from eight replicates in which the applicator hand sprayed carpet using 200 psi, then used a push broom rake to raise the carpet nap
- For the ***high-pressure spray*** scenario, the PHED dermal and inhalation unit exposure values for liquid/open pour/high pressure spray (PHED scenario 35) were used (single layer of clothing and gloves). The dermal and inhalation unit exposure values are 2.5 mg/lb a.i. and 0.12 mg/lb a.i., respectively.
- For the ***mopping*** scenarios, the CMA dermal and inhalation unit exposure values for ungloved mopping were used (71.6 mg/lb a.i. and 2.38 mg/lb a.i., respectively). These values are based on data collected from six replicates in which the applicator mopped the floor and received exposure via contact with the mop or with the bucket.
- For the ***wiping*** scenarios, the CMA dermal and inhalation unit exposure values for ungloved wiping were used (2,870 mg/lb a.i. and 67.3 mg/lb a.i., respectively). These values are based on data collected from six replicates (dental technicians) who used a finger pump sprayer to apply the product and then wiped the surfaces with a paper towel
- For the ***aerosol sprays and trigger pump spray*** scenarios, the PHED dermal and inhalation unit exposure values for aerosol applications (PHED scenario 10) were used. The dermal unit exposures (single layer of clothing) are 190 mg/lb a.i. for ungloved replicates and 81 mg/lb a.i. for gloved replicates. The inhalation unit exposure is 1.3 mg/lb a.i.
- For the ***fogging*** scenarios, it was assumed that most of the exposure to the handler will be due to preparing the fogger, and that the handler leaves the room immediately after fogging commences. Therefore, the available CMA disinfectant liquid pour dermal and inhalation unit exposure values were used. The dermal and inhalation unit exposure values are 36.5 mg/lb a.i. and 1.89 mg/lb a.i., respectively. This value is based on data collected from two gloved replicates involving pouring a disinfectant product from a jug into sterilization trays designed for dental instruments, adding water and instruments to the tray, removing the instruments, and discarding the old solution.
- For the ***liquid pour*** scenarios for materials preservatives, the unit exposure depends on the material being treated. The following CMA unite exposures were available and used for the assessment of the risk associated with the treatment of the specified materials.
    - *Metalworking fluid*: CMA metal fluid gloved data. The dermal UE is 0.184 mg/lb ai and the inhalation UE is 0.00854 mg/lb ai. The values are based on 8 replicates where the test subjects were wearing a single layer of clothing and chemical resistant gloves.
    - *Paint and Textiles*: CMA preservative gloved data. The dermal UE is 0.135 mg/lb ai and the inhalation UE is 0.00346 mg/lb ai. The values are based on 2 replicates where the test subjects were wearing a single layer of clothing and chemical resistant gloves.

- For the ***liquid pump*** scenarios, the unit exposure depends on the material being treated. The following CMA unite exposures were available and used for the assessment of the risk associated with the treatment of the specified materials.
    - *Metalworking fluid*: CMA metal fluid gloved data. The dermal UE is 0.312 mg/lb a.i. and the inhalation UE is 0.00348 mg/lb a.i. The values are based on 2 replicates where the test subjects were wearing a single layer of clothing and chemical resistant gloves.
    - *Paint and Textiles*: CMA preservative gloved data. The dermal UE is 0.00629 mg/lb a.i. and the inhalation UE is 0.000403 mg/lb a.i. for inhalation. The values are based on two replicates where the test subjects were wearing a single layer of clothing and chemical resistant gloves.
    - *Pulp and Paper*: CMA pulp and paper gloved data. The dermal UE is 0.00454 mg/lb a.i. and the inhalation UE is 0.000265 mg/lb a.i. The values are based on 7 replicates where the test subjects were wearing a single layer of clothing and chemical resistant gloves.
- For ***roller/brush*** scenarios, the occupational PHED dermal and inhalation unit exposure values for paintbrush applications (PHED scenario 22) were used (single layer of clothing). The inhalation exposure value is 0.28 mg/lb a.i. The dermal unit exposures are 180 mg/lb a.i. for ungloved replicates and 24 mg/lb a.i. for gloved replicates.
- For ***airless sprayer*** scenarios, the occupational PHED dermal and inhalation unit exposure values for airless sprayer application (PHED scenario 23) were used (single layer of clothing). The inhalation exposure value is 0.83 mg/lb a.i. The dermal unit exposures are 38 mg/lb a.i. for ungloved replicates and 14 mg/lb a.i. for gloved replicates.

Quantity handled/treated: The quantity handled/treated values were estimated based on information from various sources. The following assumptions were made:

- For the ***low-pressure handwand*** scenario**,** it was assumed that 10 gallons of solution are used in agricultural uses (Exposure Policy #009) and by standard assumptions, that 2 gallons are used in all other applications.
- For the ***high-pressure spray*** scenario**,** it was assumed that 40 gallons of solution are used (Exposure Policy #009).
- For the ***mopping*** scenario**,** it was assumed that two gallons of solution are used in the food handling and commercial/institutional/industrial setting and 45 gallons are used in the medical setting. The reason for this assumption specific to medical premises is because in hospitals, it is assumed that a janitor cleans approximately 28 rooms a day and must change the cleaning water every three rooms.
- For the ***wiping*** and ***trigger pump spray*** scenarios, it was assumed that 0.26 gallons were used based on standard assumptions of the amount used for hard surface disinfection.
- For the ***air deodorization*** scenario, it was standard assumption that 3 cans of product are used (3 x 16.5 oz = 49.5 oz, or 49.5 oz. x 1 lb/16oz. = 3.1 lbs product).
- For the ***fogging*** scenario in the *agricultural use site category*, it was assumed that 15,000 ft^2 of floor space is treated, based on the estimated dimensions of a poultry barn (300 ft x 50 ft x 10 ft).
- For the ***fogging*** scenario in the *commercial use site category*, it was assumed that a commercial operator would be treating one residential house. It was assumed that the area being fogged is the same size as the generic house described in the MCCEM Model: 408 m^3, or 14,400 ft^3 (see Section 4.4.2.6 for a discussion of the use of MCCEM in fogger

postapplication modeling). This includes the assumption that the ceilings are 8 feet high and the floor area of the house is 1801 ft^2.

- For the ***liquid pour*** scenarios, the quantity of the chemical that is handled depends on the material that is being treated. The following values were used for the different materials:
    - *Metalworking fluid*: 2,502 lbs (approximately 300 gallons, and the density of the fluid is assumed to be that of water, 8.34 lb a.i./gal) (Dang, 1997)
    - *Paint*: 2,000 lbs (approximately 200 gallons, weight based on a density 10 lb a.i./gal), and this is based on standard assumptions.
    - *Textiles*: 10,000 lbs is treated based on standard assumption.
- For the ***liquid pump*** scenarios the quantity that is handled depends on the material that is being treated. The following values were used for the different materials:
    - *Metalworking fluid*: 2,502 lbs (approximately 300 gallons, weight and the density of the fluid is assumed to be that of water, 8.34 lb ai/gal) (Dang, 1997)
    - *Paint*: 10,000 lbs (approximately 1,000 gallons, weight based on a density of 10 lb a.i./gal) and this is based on standard assumptions.
    - *Pulp and Paper*: 500 tons based on standard assumption (500 tons x 2204.622 lb/ton = 1102311 lbs)
    - *Textiles*: 10,000 lbs is treated based on standard assumption.
- For the ***roller/brush*** painting scenario, it was assumed that 50 lbs (approximately 5 gallons of paint with a density of 10 lb/gal) of treated paint are used.
- For the ***airless sprayer*** in the ***painting*** scenario, it was assumed that 500 lbs (approximately 50 gallons of paint with a density of 10 lb/gal) of treated paint are used.
- For the ***airless sprayer*** in the ***outdoor application to hard surface*** scenario, it was assumed that 40 gallons of solution are used (Exposure Policy #009).

Duration of Exposure: The MOEs were calculated for the short- and intermediate-term durations for occupational handlers using the appropriate endpoints in Table 3.2.

Table 6.2 Short and Intermediate Term Risks Associated with Occupational Handlers using OPP and OPP Salts

Exposure Scenario	Method of Application	Unit Exposure (mg/lb a.i.)			App. Rate	Quantity Handled/ Treated per day	Absorbed Daily Dose (mg/kg/day)[c]					MOE[d]							
		Baseline Dermal[a]	PPE-Gloves Dermal[b]	Inhalation			Baseline Dermal[a]		PPE-Gloves Dermal[b]		Inhal. ST/IT	Baseline Dermal (Target MOE = 100)[a]		PPE-Gloves Dermal (Target MOE = 100)[b]		Inhalation (Target MOE = 100)		IT Total MOE (Target MOE = 100)	
							IT	ST	IT	ST		IT	ST	IT	ST	IT	ST	Baseline	PPE
Agricultural Premises and Equipment (Use Site Category I)																			
Application to hard surfaces	Low Pressure Handwand	191	N/A	0.681	0.0183 lb ai/gal	10 gal	0.21	0.5	N/A	N/A	0.0018	180	200	N/A	N/A	22,000	56,000	180	N/A
	High Pressure Handwand	N/A[e]	2.5	0.12	0.0183 lb ai/gal	40 gal	N/A	N/A	0.011	0.026	0.0013	N/A	N/A	3,500	3,800	31,000	80,000	N/A	3,100
	Mopping	71.6	N/A	2.38	0.0183 lb ai/gal	2 gal	0.016	0.037	N/A	N/A	0.0012	2,400	2,700	N/A	N/A	31,000	80,000	2,200	N/A
	Wiping	2870	N/A	67.3	0.0183 lb ai/gal	0.26 gal	0.084	0.2	N/A	N/A	0.0046	460	510	N/A	N/A	8,500	22,000	440	N/A
	Trigger Pump Spray	190	81	1.3	0.0183 lb ai/gal	0.26 gal	0.0056	0.013	0.0024	0.0055	0.0001	7,000	7,700	16,000	18,000	440000	$1.1x10^6$	6,900	15,000
Fogger	Liquid Pour of soluble concentrate	N/A	36.5	1.89	0.661 lb ai/6,000 ft^2	15,000 ft^2	N/A	N/A	0.37	0.86	0.045	N/A	N/A	110	120	**880**	2,200	N/A	**98**
Food Handling (Use Site Category II)																			
Application to indoor hard surfaces	Low Pressure Handwand	191	N/A	0.681	0.00391 lb ai/gal	2 gal	0.0092	0.02	N/A	N/A	0.0001	4,300	4,700	N/A	N/A	510,000	$1.3x10^6$	4,300	N/A
	Mopping	71.6	N/A	2.38	0.00391 lb ai/gal	2 gal	0.0034	0.008	N/A	N/A	0.0003	11,000	13,000	N/A	N/A	150,000	380,000	10,000	N/A
	Wiping	2870	N/A	67.3	0.00391 lb ai/gal	0.26 gal	0.018	0.04	N/A	N/A	0.0010	2,200	2,400	N/A	N/A	40,000	100,000	2,100	N/A

Table 6.2 Short and Intermediate Term Risks Associated with Occupational Handlers using OPP and OPP Salts

Exposure Scenario	Method of Application	Unit Exposure (mg/lb a.i.)			App. Rate	Quantity Handled/ Treated per day	Absorbed Daily Dose (mg/kg/day)[c]					MOE[d]							
		Baseline Dermal[a]	PPE-Gloves Dermal[b]	Inhalation			Baseline Dermal[a]		PPE-Gloves Dermal[b]		Inhal. ST/IT	Baseline Dermal (Target MOE = 100)[a]		PPE-Gloves Dermal (Target MOE = 100)[b]		Inhalation (Target MOE = 100)		IT Total MOE (Target MOE = 100)	
							IT	ST	IT	ST		IT	ST	IT	ST	IT	ST	Baseline	PPE
	Trigger Pump Spray	190	81	1.3	0.0034 lb ai/gal	0.26 gal	0.001	0.0024	0.0004	0.001	$1.6x10^{-5}$	38,000	42,000	89,000	98,000	2.4e+06	6.1e+06	37,000	86,000
Commercial/Institutional Premises (Use Site Category III)																			
Application to indoor hard surfaces	Low Pressure Handwand	191	N/A	0.681	0.0183 lb ai/gal	2 gal	0.043	0.1	N/A	N/A	0.00036	910	1,000	N/A	N/A	110,000	280,000	900	N/A
	Mopping	71.6	N/A	2.38	0.0126 lb ai/gal	2 gal	0.111	0.258	N/A	N/A	0.0086	350	390	N/A	N/A	4,600	1,200	330	N/A
	Wiping	2870	N/A	67.3	0.0126 lb ai/gal	0.26 gal	0.578	1.34	N/A	N/A	0.0031	**68**	**74**	N/A	N/A	1,200	3,200	**64**	N/A
	Trigger Pump Spray	190	81	1.3	0.0334 lb ai/gal	0.26 gal	0.010	0.024	0.0043	0.01	$1.6x10^{-4}$	3,800	4,200	9,000	10,000	$2.4x10^{5}$	$6.2x10^{5}$	3,700	8,700
Application to outdoor hard surfaces	Airless sprayer	38	14	0.83	0.00104 lb ai/gal	40 gal	0.0097	0.023	0.0036	0.0083	0.00049	4,000	4,400	11,000	12,000	79,000	200,000	3,800	9,700
Air deodorization	Aerosol Spray	190	81	1.3	0.199% ai by weight	3 16-oz cans	0.007	0.0162	0.003	0.007	0.00011	5,600	6,200	13,000	14,000	350,000	900,000	5,500	13,000
Fogging	Liquid pour of soluble concentrate	N/A	36.5	1.89	0.019 lb a.i./6,000 ft2	1,801 sq. ft.	N/A	N/A	0.001	0.003	0.0002	N/A	N/A	880	970	250,000	650,000	N/A	28,000
Medical Premises and Equipment (Use Site Category V)																			
Application to indoor hard surfaces	Low Pressure Handwand	191	N/A	0.681	0.0183 lb ai/gal	2 gal	0.043	0.1	N/A	N/A	0.00036	910	1,000	N/A	N/A	110,000	280,000	902	N/A

Table 6.2 Short and Intermediate Term Risks Associated with Occupational Handlers using OPP and OPP Salts

Exposure Scenario	Method of Application	Unit Exposure (mg/lb a.i.)			App. Rate	Quantity Handled/ Treated per day	Absorbed Daily Dose (mg/kg/day)[c]					MOE[d]							
		Baseline Dermal[a]	PPE-Gloves Dermal[b]	Inhalation			Baseline Dermal[a]		PPE-Gloves Dermal[b]		Inhal. ST/IT	Baseline Dermal (Target MOE = 100)[a]		PPE-Gloves Dermal (Target MOE = 100)[b]		Inhalation (Target MOE = 100)		IT Total MOE (Target MOE = 100)	
							IT	ST	IT	ST		IT	ST	IT	ST	IT	ST	Baseline	PPE
	Mopping	71.6	N/A	2.38	0.0234 lb ai/gal	45 gal	0.46	1.1	N/A	N/A	0.036	**84**	**93**	N/A	N/A	1,100	2,800	**78**	N/A
	Wiping	2870	N/A	67.3	0.0234 lb ai/gal	0.26 gal	0.11	0.25	N/A	N/A	0.0058	360	400	N/A	N/A	6,700	17,000	340	N/A
	Trigger Pump Spray	190	81	1.3	0.0334 lb ai/gal	0.26 gal	0.01	0.024	0.0043	0.01	$1.6x10^{-5}$	3,800	4,200	9,000	10,000	240,000	620,000	3,700	8,700
Air deodorization	Aerosol Spray	190	81	1.3	0.199 % ai by weight	3 16-oz cans	0.007	0.016	0.003	0.007	0.00011	5,600	6,200	13,000	14,000	350,000	900,000	5,500	1/3,000
Material Preservatives (Use Site Category VII)																			
Preservation of Metalworking Fluid	Liquid Pour	N/A	0.184	0.0085	5.66% ai by weight	2,502 lbs	N/A	N/A	0.16	0.372	0.017	N/A	N/A	240	270	2,300	5,800	N/A	220
	Liquid Pump	N/A	0.312	0.00348	5.66% ai by weight	2,502 lbs	N/A	N/A	0.27	0.631	0.007	N/A	N/A	140	160	5,500	14,000	N/A	140
Preservation of Paint	Liquid Pour	N/A	0.135	0.00346	0.56% ai by weight	2,000 lbs (200 gal)	N/A	N/A	0.0093	0.0216	0.0006	N/A	N/A	4,200	4,600	70,000	180,000	N/A	4,000
	Liquid Pump	N/A	0.00629	0.000403	0.56% ai by weight	10,000 lbs (1,000 gal)	N/A	N/A	0.0022	0.005	0.0003	N/A	N/A	18,000	20,000	120,000	310,000	N/A	16,000
Preservation of Pulp and Paper	Liquid Pump	N/A	0.00454	0.000265	0.34% ai by weight	500 tons	N/A	N/A	0.11	0.245	0.014	N/A	N/A	370	410	2,700	6,900	N/A	330

Table 6.2 Short and Intermediate Term Risks Associated with Occupational Handlers using OPP and OPP Salts

Exposure Scenario	Method of Application	Unit Exposure (mg/lb a.i.)			App. Rate	Quantity Handled/ Treated per day	Absorbed Daily Dose (mg/kg/day)[c]					MOE[d]							
		Baseline Dermal[a]	PPE-Gloves Dermal[b]	Inhalation			Baseline Dermal[a]		PPE-Gloves Dermal[b]		Inhal. ST/IT	Baseline Dermal (Target MOE = 100)[a]		PPE-Gloves Dermal (Target MOE = 100)[b]		Inhalation (Target MOE = 100)		IT Total MOE (Target MOE = 100)	
							IT	ST	IT	ST		IT	ST	IT	ST	IT	ST	Baseline	PPE
Preservation of Textiles	Liquid Pour	N/A	0.135	0.00346	5.66% ai by weight	10,000 lbs	N/A	N/A	0.047	1.09	0.0028	N/A	N/A	**83**	**92**	1,400	3,600	N/A	**78**
	Liquid Pump	N/A	0.00629	0.000403	5.66% ai by weight	10,000 lbs	N/A	N/A	0.022	0.051	0.0003	N/A	N/A	1,800	2,000	12,000	31,000	N/A	1,600
Application of Paint by professionals	Brush/ Roller	180	24	0.28	0.56% ai by weight	50 lbs	NC	0.72	NC	0.096	0.0011	NC	140	NC	1,000	NC	89,000	NC	NC
	Airless Sprayer	38	14	0.83	0.56% ai by weight	500 lbs	NC	1.52	NC	0.56	0.033	NC	**66**	NC	180	NC	3,000	NC	NC

ST = short-term, IT = intermediate-term, N/A= No data available

a Baseline Dermal: Long-sleeve shirt, long pants, no gloves.

b PPE Dermal with gloves: baseline dermal plus chemical-resistant gloves.

c Absorbed Daily dose (mg/kg/day) = [unit exposure (mg/lb ai) * absorption (1.0 for ST/IT inhalation and ST dermal, 0.43 for IT dermal) * application rate * quantity treated / Body weight (70 kg).

d MOE = NOAEL (mg/kg/day) / Absorbed Daily Dose [Where short-term NOAEL = 100 mg/kg/day for dermal and inhalation exposures and intermediate-term NOAEL = 39 mg/kg/day for dermal and inhalation exposures].

e No ungloved data available such that only a gloved scenario was assessed. Although there is a potential that a handler may be exposed to a high pressure spray scenario, the MOE values were well above the target MOE, such that AD assumes that the ungloved scenario will also produce acceptable MOEs.

f Total IT MOE = 1/((1/Dermal IT MOE) + (1/Inhalation IT MOE))

NC = Not conducted: IT exposures were not assessed for professional painters because it was assumed that professional painters will not use OPP preserved paint on a continuous basis

Exposure Calculations and Results

The calculated dermal, inhalation, and IT Total MOEs are shown in Table 6.2. All MOEs in the occupational setting were above the target MOE of 100 for dermal, inhalation and total exposures, except for the following scenarios:

- Agricultural premises, fogging: intermediate-term PPE Total MOE = 98
- Commercial/Institutional premises, wiping: short-term baseline dermal MOE= 74, intermediate-term baseline dermal MOE = 68, and intermediate-term baseline Total MOE = 64.
- Medical premises, mopping: short-term baseline dermal MOE= 93, intermediate-term baseline dermal MOE = 84, and intermediate-term baseline Total MOE = 78.
- Materials Preservatives, liquid pour preservation of textiles: short-term PPE dermal MOE= 92, intermediate-term PPE dermal MOE = 83, and intermediate-term Total MOE = 78.
- Materials Preservatives, painter (applying paint post-preservation), airless sprayer: baseline dermal short-term MOE = 66.

It should be noted that although the target inhalation MOE is 100, if the MOE is below 1,000 the Agency may request a confirmatory inhalation toxicity study because the current inhalation endpoint is based on an oral NOAEL. All of the occupational inhalation MOEs were above 1,000, except for the following scenarios:

- Agricultural equipment, fogger MOE = 880

6.1.1 Professional Painter Inhalation (vapor) Exposure

Table 6.2 presents the exposures and risks associated with the application of OPP or OPP Salt preservative to the paint. In this section, the professional painter inhalation exposure to OPP vapors during paint activities was assessed. AD utilized EPA's Wall Paint Exposure Model (WPEM) version 3.2 to estimate air concentrations resulting from the use of paint preserved with OPP. For this professional painter exposure assessment, the WPEM default scenario for the residential professional painter (RESPROF) was used. This WPEM default scenario assumes that two professional painters are exposed to a chemical in paint while painting an entire apartment per working day. For a detailed description of the default RESPROF scenario, see the WPEM User's Guide. The following chemical-specific inputs were used in the model:

- OPP's molecular weight (170.19 amu) and vapor pressure (0.002 mm Hg)
- The weight fraction of OPP in paint (product #464-126 contains 0.5% OPP)

The model provides several dose measures (i.e., LADD, ADD), air concentration measures (i.e., peak, 15-min, 8hr), and a comma-separated (.csv) file as outputs. The comma-separated file contains details on time-varying concentrations within the modeled building as well as concentrations to which the individual is exposed. This file can be read directly into spreadsheet software (e.g., Excel) for calculating additional summary statistics. The air concentrations outputted by the model were used by AD to estimate inhalation exposure doses and MOEs. It should be noted that only short-term exposures were assessed because it was assumed that professional painters would not use an OPP-preserved paint on a continuous basis. The model results and exposure calculations are summarized in Table 6.3. The MOE for the short-term inhalation exposure for the professional painter is below the target MOE of 100 (MOE = 43).

Table 6.3. Short-Term Inhalation (vapor) Exposures and MOEs for Professional Painters Using OPP-Preserved Paint

Average Air Conc. (mg/m^3)[a]	Exposure Duration (hrs/day)	Inhal. Rate (m^3/hr)[b]	Inhalation Dose (mg/kg/day)[c]	ST Inhalation MOE (Target = 100)
18.16	9	1.00	2.33	**43**

[a]9-hr Time Weighted Average (TWA) during the painting activity (See Appendix E)
[b]Inhalation rate for light activity (USEPA, 1997)
[c]Inhalation Dose = 9-hr TWA * Inhalation Rate * exposure duration / Body Weight (70 kg for adults)
[d]Short Term Inhalation MOE = Short-Term Inhalation NOAEL (100 mg/kg/day) / Inhalation Dose

6.1.2 Industrial Bystander Inhalation Exposure

Inhalation exposures are expected to occur to bystanders as a result of material preservative applications in industrial settings. Currently, no data are available to assess these bystander exposures and therefore, monitoring data are needed.

6.2 Occupational Post-application Exposures

6.2.1 Fogging

Post-application inhalation exposures were only assessed for entry into a building after a fogging application, because dermal post application is presumed to be negligible. The inhalation exposure assessment was conducted using the Multi-Chamber Concentration and Exposure Model (MCCEM v1.2). MCCEM estimates average and peak indoor air concentrations of chemicals released from products or materials in houses, apartments, townhouses, or other residences. Although the data libraries contained in MCCEM are limited to residential settings, the model can be used to assess other indoor environments. MCCEM has the capability to estimate inhalation exposures to chemicals, calculated as single day doses, chronic average daily doses, or lifetime average daily doses. (All dose estimates are potential doses; they do not account for actual absorption into the body.)

One product, EPA Reg #65020-7, which can be used for fogging (7.92% OPP), was assessed for use in a poultry house or livestock building. The label states that the product is to be applied at a rate of 1 gallon of product per 6,000 square feet. After fogging, the label

states that the building should be kept closed for 24 hrs. Therefore, exposure was calculated for a person entering the building 24 hours after all the applied fogger has been deployed.

Assumptions used to calculate inputs for MCCEM and the calculated exposure values are presented in Table 6.4. The following assumptions were made:

- The area being fogged is a one-chamber barn with dimensions of 300 ft x50 ft x10 ft (AD standard assumption) and an air exchange rate of 0.18 per hour
- Fogging occurs instantaneously, so that the entire mass of product is mixed homogeneously with the indoor air as soon as fogging commences.

A number of labels for fogging products make statements pertaining to the fact that if the fogger is used in well-ventilated areas, such as hatcheries, the re-entry interval can be as low as 1-2 hours. Scenarios in well-ventilated areas such as hatcheries were not assessed in this document.

Table 6.4. Short and Intermediate Term Inhalation Risks Associated with Postapplication Exposure OPP and OPP salts After Fogging a Barn

Parameter	Value	Rationale
Barn Dimensions*	300x50x10 ft, 15,000 ft^2 floor area, 150,000 ft^3 (4,248 m^3) volume	EPA Assumption
Air Changes per Hour (ACH)*	0.18/hr	EPA Assumption
Activity Pattern*	8 hour Time Weight Average (TWA) starting at expiration of 24-hr REI	Based on product's re-entry interval (EPA Registration No. 65020-7).
Concentration of Fogging Liquid	7.92% a.i. (OPP)	Product Label (See Table 6.1)
Use rate	1 gal/6000 ft^2	Product label
Mass applied to barn	1.65 lbs a.i. (750 g a.i.)	(Use rate) x (Concentration) x (Floor area)
Concentration in barn after fogging (initial concentration rate at time 0)*	0.177 g/m^3	Mass / Volume
Body Weight	70 kg	EPA Assumption
Inhalation Rate	1.00 m^3/hr	Light Activity for Adults (USEPA, 1997)
MCCEM Output		
Average Concentration over 8-hrs	1.27 mg/m^3	Average of MCCEM-calculated air concentrations from Hour 24 to Hour 32
8-hr Dose (mg/kg/day)	0.145	Average Conc. * 8 hrs * Inhal. Rate / BW
8-hr short-term MOE	690	NOAEL (100 mg/kg/day) / Dose

Table 6.4. Short and Intermediate Term Inhalation Risks Associated with Postapplication Exposure OPP and OPP salts After Fogging a Barn		
Parameter	Value	Rationale
8-hr intermediate-term MOE	270	NOAEL (39 mg/kg/day) / Dose

*Used as MCCEM input. Default values from MCCEM were used for all inputs not listed in the table above

A detailed model report is presented in Appendix D. Based on MCCEM .csv output, MOE values were calculated. Both the short-term MOE (690) and the intermediate-term MOE (270) were above the target MOE of 100 but below 1,000. Therefore, the Agency may request that a confirmatory inhalation toxicity study be submitted since the current inhalation endpoint is based on an oral toxicity study.

6.3 Metalworking Fluids: Machinist

There is a potential for dermal and inhalation exposure when a worker handles treated metalworking fluids. This route of exposure occurs after the chemical has been incorporated into the metalworking fluid and a machinist is using/handling this treated end-product.

Dermal Exposures

Exposure Calculations

A ST and a IT/LT estimate were derived using the 2-hand immersion model from ChemSTEER. The model is available at www.epa.gov/opptintr/exposure/docs/chemsteer.htm. The 2-hand immersion equation is as follows:

$$PDR = \frac{SA \times \% ai \times FT \times FQ}{BW}$$

where:

PDR	=	Potential dose rate (mg/kg/day);
SA	=	Surface area of both hands (cm^2);
% ai	=	Fraction active ingredient in treated metalworking fluid (unitless)
FT	=	Film thickness of metal fluid on hands (mg/cm^2)
FQ	=	Frequency of events (event/day);
BW	=	Body weight (kg)

Assumptions

- The surface of area of both hands is 840 cm^2 (US EPA 1997)
- The body weight of an adult is 70 kg (US EPA 1997)
- The percent active ingredient was selected from the label that provides an application rate for the non-concentrate fluid (EPA Registration No. 464-126, this is 1.5 %)
- For intermediate- and long-term durations, the film thickness on the hands is 1.75 mg/cm^2, which was extracted from the document titled, "A Laboratory Method to Determine the

Retention of Liquids on the Surface of Hands." The film thickness is based on a machinist immersing both hands in metalworking fluid and then partially cleaning hands with a rag. The film thickness was chosen because the dermal endpoint for the intermediate- and long-term durations is based on systemic effects.

- For short-term durations, the film thickness on the hands is 10.3 mg/cm^2, which is from the document titled, "A Laboratory Method to Determine the Retention of Liquids on the Surface of Hands." The film thickness is based on a machinist completing a double dip in which both hands are immersed and remain wet. The film thickness was chosen because the dermal endpoint for short-term durations is based on dermal irritation effects.

Results

Table 6.5 shows the calculation of the dermal doses and dermal MOEs for a machinist working with metal fluids. The MOE value is above the target MOE of 100 for intermediate- and long-term exposures (MOE = 290). However, there is concern with short term exposure because the calculated MOE of 54 is below the target MOE of 100.

Table 6.5. Short, Intermediate, and Long Term Dermal Risks Associated With Postapplication Exposure to Metalworking Fluids Treated With OPP (Machinist)

Exposure Scenario	% ai	Hand Surface Area (cm^2)	Film thickness (mg/cm^2)	Frequency (event/day)	Absorbed Daily Dose[a] (mg/kg/day)		Dermal MOE (Target MOE is 100) [b]	
					ST	IT/LT	ST	IT/LT
Machinist - two hand immersion	1.5%	840	10.3 for ST 1.75 for IT/LT	1	1.85	0.13545	**54**	290

a Absorbed Daily Dose, normalized to body weight (mg/kg/day) = [(% active ingredient * dermal absorption factor (0.43 for IT/LT exposure and not applicable to ST exposures) * film thickness (mg/cm^2)* Frequency (event/day)] / Body weight (70 kg).

b MOE = NOAEL (mg/kg/day) / Absorbed Daily Dose (mg/kg/day) [Where: short-term NOAEL = 100 mg/kg/day and intermediate- and long-term NOAEL = 39 mg/kg/day for dermal exposures, Table 3.2].

Inhalation Exposures

The screening-level intermediate and long term inhalation exposure estimate for treated metalworking fluids have been developed using the OSHA PEL for oil mist. The equation used for calculating the inhalation dose is:

$$PDR = \frac{PEL \times IR \times \%\ ai \times ED}{BW}$$

where:

PDR	=	Potential dose rate (mg/kg/day);
PEL	=	OSHA PEL (mg/m^3);
IR	=	Inhalation rate (m^3/hr)
% ai	=	Fraction active ingredient in treated metalworking fluid (unitless)
ED	=	Exposure duration (hrs/day);
BW	=	Body weight (kg)

Assumptions

- The high-end oil mist concentration is based on OSHA's Permissible Exposure Limit (PEL) of 5 mg/m^3 (NIOSH, 1998).
- The percent active ingredient was selected from the label that provides an application rate for the non-concentrate fluid (EPA Registration No. 464-126).
- The inhalation rate for a machinist is 1.25 m^3/hr.
- A machinist is exposed to the metalworking fluid 8 hours a day, for 5 days a week.
- The body weight of an adult is 70 kg (US EPA 1997).

Results

Table 6.6 shows the calculation of the dermal doses and MOEs for a machinist working with metalworking fluids. The inhalation MOE values for IT/LT and ST exposures to OPP and OPP salts are above the target MOE of 100 (IT/LT MOE = 3,600 and ST MOE = 9,300). Furthermore, these MOEs are also above 1,000 therefore a confirmatory inhalation toxicity study is **not** warranted based on the results of this scenario.

Table 6.6. Short, Intermediate, and Long Term Inhalation Risks Associated with Postapplication Exposure to Metalworking Fluids treated with OPP (Machinist)

Exposure Scenario	% a.i.	OSHA PEL (mg/m^3)	Inhalation rate (m^3/hr)	Exposure Duration (hrs/day)	Absorbed Daily Dose[a] (mg/kg/day)	Inhalation MOE (Target MOE is 100) [b]	
					ST/IT/LT	ST	IT/LT
Machinist	1.5%	5	1.25	8	0.0107	9,300	3,600

a Absorbed daily dose (mg/kg/day) = % active ingredient * OSHA PEL (mg/m3) * Inhalation rate (m3/hr) * exposure duration (hr/day) / body weight (70 kg)

b MOE = NOAEL (mg/kg/day) / absorbed daily dose (mg/kg/day) [Where: short-term NOAEL = 100 mg/kg/day and intermediate- and long-term NOAEL = 39 mg/kg/day for inhalation exposures, Table 3.2].

The intermediate-term Total MOE was also calculated and compared to the target MOE of 100. It was necessary to estimate intermediate-term Total MOEs because the toxicological effects from the dermal and inhalation routes are the same (Table 3.2). The Total MOE was 270 and is well above the target MOE of 100.

6.4 Wood Preservation

OPP and OPP salts are used in products that are intended to preserve wood (non-pressure treatment). As noted on label Reg # 67869-24, OPP Salt for wood preservation serves the purpose, *"for the temporary protection of freshly sawn lumber against staining and molding. [The product] are applied to the freshly sawn lumber by either dipping or spraying."* The label also provides four categories of recommended dosages, which include construction woods, fresh cut lumber, fruit and vegetable containers, and pallets. In addition, the handler and post application scenarios that have been identified and assessed for wood preservation were extracted from MRID 455243-04, "*Measurement and Assessment of Dermal and Inhalation Exposures to Didecyl Dimethyl Ammonium Chloride (DDAC) Used*

in the Protection of Cut Lumber (Phase III)" (Bestari et al., 1999). This proprietary sapstain task force study (task force # 73154) includes the potential ways that the Agency believes an individual can come into contact with preserved wood, and therefore is included in this assessment.

Handler:

- ***Blender/spray operators*** are workers that add the wood preservative into a blender/sprayer system for composite wood via closed-liquid pumping.
- ***Chemical operators*** consist of chemical operators, chemical assistants, chemical supervisors, and chemical captains. These individuals maintain a chemical supply balance and are assigned the task of flushing and cleaning spray nozzles.
- ***Diptank Operators*** can be in reference to wood being lowered into the treating solution through an automated process (i.e.: elevator diptank, forklift diptank). This scenario can also occur in a small scale treatment facility in which the worker can manually dip the wood into the treatment solution.

Post-application:

- ***Graders*** are expected to be positioned right after the spray box sequence and grade the dry lumber by hand (i.e. detect faults). In the DDAC study, graders graded wet lumber; therefore, the exposures to graders using OPP and OPP salts are assumed to be the worst-case scenarios.
- ***Trim saw operators*** operate the hula trim saw and this group consists of operators and strappers.
- ***Millwrights*** repair all conveyer chains and are involved in a general up-keep of the mill.
- ***Clean-up crews*** perform general cleaning duties at the mill.
- ***Construction workers*** install treated plywood, oriented strand board, medium density fiberboard, and others.

The CMA unit exposure data were used to assess exposure and risks for the job function that involves blender/spray operators. The liquid pump preservative unit exposures for gloved workers were used. The dermal UE was 0.00629 mg/lb ai and the inhalation UE was 0.000403 mg/lb ai. These values are based on two replicates where the test subjects were wearing a single layer of clothing and chemical resistant gloves. The quantity of the wood being treated was derived from standard Agency assumptions for the amount of wood slurry treated because no chemical specific data were available for OPP. It was assumed that batches of 7,000 gallons of wood slurry are treated in a batch for wood blender type operations. The Agency also assumed that eight batches of wood slurry were treated per day (one per hour for an 8-hr work shift). The total amount of wood slurry treated per day would therefore be 56,000 gallons or 213 m^3 (where, 56,000 gal/day = 7,000 gallons/batch x 8 batches/day; or 213 m^3 = 56,000 gallons x 0.003785 m^3/gallon). Wood chips were assumed to have a density of about 380 kg/m^3 (SIMetric, 2005), and with this assumption, a potential amount of 178,000 lbs of wood is expected to be treated (213 m^3 x 380 kg/m^3 x 2.2 lb/kg). The OPP product is to be applied at a rate of 4.52% a.i. (20% OPP applied at 22.6% by weight of the wood treated) by weight. Table 6.7 provides the short, intermediate term, and total MOEs (IT) for the workers adding the preservative to the wood slurry. All of the MOEs are above the target MOE of 100 and therefore do not pose a concern. However, the IT inhalation MOE (840) for

the blender/spray operators adding the chemical via closed-liquid pumping is less than 1,000 and therefore a confirmatory inhalation toxicity study is warranted based on these results.

Table 6.7 Short- and Intermediate-term Exposures and MOEs for Wood Preservative Blender/spray Operators

Exposure Scenario	CMA Dermal UE (mg/lb ai)	CMA Inhal UE (mg/lb ai)	App Rate (% ai)	Quantity Treated (lb/day)	Daily Dermal Dose [a] (mg/kg/day)		Daily Inhal. Dose [a] (mg/kg/day)	Dermal MOE [b]		Inhalation MOE [b]		Total IT MOE [c]
					ST	IT		ST	IT	ST	IT	
Liquid Pump	0.00629	0.000403	4.52%	178,000	0.723	0.311	0.0463	140	130	2,200	840	110

a Daily Dose = UE (mg/lb ai) x App Rate (% ai) x Quantity treated (lb/day) x absorption factor (IT/LT dermal = 0.43, not necessary for ST dermal and all durations for inhalation)/ BW (70 kg)

b MOE = NOAEL (mg/kg/day)/ Daily dose [Where short-term NOAEL = 100 mg/kg/day for dermal and inhalation exposures and intermediate-term NOAEL = 39 mg/kg/day for dermal and inhalation exposures]. Target MOE is 100 for dermal and inhalation exposures

c Total IT MOE = $1/ ((1/MOE_{dermal}) + (1/MOE_{inhalation}))$

Chemical Operators, Graders, Millwrights, Clean-up Crews, and Trim Saw Operators

The CMA data were inadequate to represent the other job functions associated with preservation on non-pressure treated wood. As very little chemical specific data were available regarding typical exposures OPP and its salts as a wood preservative, surrogate data were used to estimate exposure risks. This surrogate data was obtained from, *Measurement and Assessment of Dermal and Inhalation Exposures to Didecyl Dimethyl Ammonium Chloride (DDAC) Used in the Protection of Cut Lumber (Phase III)* (Bestari et al., 1999). This study is proprietary (Task Force # 73154); therefore, data compensation needs to be paid for use of the data in this exposure assessment. It was assumed that the workers at facilities using OPP and OPP salt preservatives are performing similar tasks as those monitored in the DDAC study.

The DDAC study examined individuals' exposure to DDAC while working with antisapstains and performing routine tasks at 11 sawmills/planar mills. Dermal and inhalation exposure monitoring data were gathered for each job function of interest using dosimeters and personal sampling tubes. Dosimeters and personal air sampling tubes were analyzed for DDAC, and the results were reported in terms of mg DDAC exposure per person per day. The study reported average daily exposures for workers in various categories. Exposure data for individuals performing the same job functions were averaged together to determine job specific averages. Total exposures from 2 trim saw workers, 13 grader workers, 11 chemical operators, 3 millwrights, and 6 clean-up staff were used.

The individual dermal and inhalation exposures from the DDAC study are presented in Table C-1 in Appendix C. To determine OPP exposures, the average DDAC exposures measured on individuals (in terms of total mg DDAC) were multiplied by a modification factor of 0.25 to account for the difference in percent active ingredient (20% OPP in the wood preservative product versus 80% DDAC in the comparative wood preservative product). The

pound (lb) active ingredient handled by each person or the percent active ingredient in the treatment solution was not provided for these worker functions.

The following equation was used to calculate daily dose for OPP and Salts:

$$Daily\ Dose = \frac{DDAC\ UE \times CR \times AB}{BW}$$

Where:

DDAC UE	=	DDAC dermal or inhalation unit exposure (mg/day);
CR	=	Conversion ratio (20% OPP / 80% DDAC);
AB	=	Absorption factor (43 % for IT/LT dermal and 100% for all other durations); and
BW	=	Body weight (70 kg).

In using this methodology, the following assumptions were made:

- DDAC and OPP end products will be used in similar quantities.
- The procedures for applying both chemicals are similar.
- The physical-chemical properties that affect the transport of the chemical are similar.
- The limits of detections (LOD) for inhalation residues from chemical operators, graders, mill wrights, and clean-up staff replicates were not provided in the DDAC report. For lack of better data, it was assumed that the inhalation LODs for these worker positions are equal to the LOD of the diptank operator replicates (5.6 ug). For all measurements below the air concentration associated with this detection limit, half the detection limit was used. The dermal LOD for all operators is also 5.6 ug.
- In the DDAC study, dermal exposures to hands were measured separately from the rest of the body. For each replicate, the body dose measurements and hand dose measurements were summed for a total dermal dose.
- Air concentrations were reported in the DDAC study. To convert air concentrations ($\mu g/m^3$) into terms of inhalation unit exposure (mg/day), the air concentrations were multiplied by an inhalation rate of 1.0 m^3/hr for light activity (EPA 1997), a sample duration of 8 hrs/day, and a conversion factor of 1 mg/1000 µg. Table C-1 in Appendix C presents the inhalation and dermal DDAC exposures.
- Average DDAC dermal and inhalation exposures were multiplied by a conversion ratio of 0.25 to account for the differences in OPP and DDAC concentrations [(20% OPP / 80% DDAC)].

Table 6.8 provides the short-, intermediate-, and long-term doses and MOEs for chemical operators, graders, millwrights, clean-up crews, and trim saw operators. For all worker functions, the dermal, inhalation and total MOEs are not of concern.

Table 6.8 Short-, Intermediate- and Long-Term Exposures and MOEs for Wood Preservative Chemical Operators, Graders, Trim Saw Operators, and Clean-Up Crews											
Exposure Scenario[a] (number of volunteers)	Dermal UE[b] (mg/day)	Inhalation UE[b] (mg/day)	Conversion Ratio[c]	Absorbed Daily Doses[d] (mg/kg/day)			MOEs (target MOE = 100)[e]				
				Dermal		Inhalation	Dermal		Inhalation		Total IT MOE
				ST	IT/LT	ST/IT/LT	ST	IT/LT	ST	IT/LT	
Occupational Handler											
Chemical Operator (n=11)	9.81	0.0281	0.25	0.0350	0.0151	0.0001	2,900	2,600	1.0x10E06	3.9x10E05	2,600
Occupational Post-application											
Grader (n=13)	3.13	0.0295	0.25	0.0112	0.0048	0.0001	8,900	8,100	9.5x10E05	3.7x10E05	7,900
Trim Saw (n=2)	1.38	0.061	0.25	0.0049	0.0021	0.0002	20,000	18,000	4.6x10E05	1.8x10E05	17,000
Millwright (n=3)	12.8	0.057	0.25	0.0457	0.0197	0.0002	2,200	2,000	4.9x10E05	1.9x10E05	2,000
Clean-Up (n=6)	55.3	0.60	0.25	0.198	0.0849	0.0021	510	460	47,000	18,200	450

ST = Short-term duration; IT = Intermediate-term duration; and LT = long-term duration

a. The exposure scenario represents a worker wearing short sleeve shirts, cotton work trousers, and cotton glove dosimeter gloves under chemical resistant gloves. Volunteers were grouped according to tasks they conducted at the mill.

b. Dermal and inhalation unit exposures are from Bestari et al (1999). Refer to Table A-1 in Appendix A for the calculation of the dermal and inhalation exposures. Inhalation exposures (mg/day) were calculated using the following equation: air concentration (ug/m^3) x inhalation rate (1.0 m^3/hr) x sample duration (8 hr/day) x unit conversion (1 mg/1000 ug). The inhalation rate is from USEPA, 1997a.

c. Conversion Ratio = 20% OPP/ 80% DDAC

d. Absorbed Daily Dose (mg/kg/day) = exposure (mg/day) * conversion ratio (0.25) * absorption factor (43% for IT/LT dermal and 100% for all other exposures/durations) / body weight (70 kg).

e. MOE = NOAEL (mg/kg/day)/ Daily Dose [Where ST NOAEL = 100 mg/kg/day for dermal and inhalation exposures, and the IT/LT NOAEL = 39 mg/kg/day for all durations]. Target MOE is 100 for dermal and inhalation exposures.

Diptank Operators

Exposures to diptank operators were also assessed using surrogate data from the DDAC study (Bestari et al., 1999). The diptank scenario assessment was conducted differently than for the other job functions because the concentration of DDAC in the diptank solution was provided. The exposure data for diptank operators wearing gloves were converted into "unit exposures" in terms of mg a.i. for each 1% of concentration of the product. The calculations of the dermal and inhalation unit exposures (2.99 and 0.046 mg/1% solution, respectively) are presented in Table C-2 in Appendix C. The air concentrations presented in the DDAC study were converted to unit exposures using an inhalation rate of 1.0 m^3/hr (light activity) and sample duration of 8 hrs/day.

The following equations are used to estimate dermal and inhalation handler exposure:

$$Daily\ Dose = \frac{DDAC\ UE \times AI \times AB}{BW}$$

Where:

DDAC UE	=	DDAC dermal unit exposure (mg/1% in solution);
AI	=	Percent active ingredient in solution (4.52%);
AB	=	Absorption factor (43 % for IT/LT dermal and 100% for all other durations); and
BW	=	Body weight (70 kg).

Table 6.9 provides the short-, intermediate-, and long-term exposures and MOEs for diptank operators. All of the dermal, inhalation, and total MOEs were above the target MOE of 100.

Table 6.9. Short-, Intermediate-, and Long-Term Exposures and MOEs for Diptank Operator

Exposure Scenario[a] (number of replicates))	Dermal Unit Exposure[b] (mg DDAC/1% solution)	Inhalation Unit Exposure[b] (mg DDAC/1%	Application Rate (% a.i. in solution/ day)[c]	Absorbed Daily Doses[c] (mg/kg/day)			MOEs[d] (target MOE = 100)				
				Dermal		Inhalation	Dermal		Inhalation		Total IT MOE
				ST	IT/LT	ST/IT/LT	ST	IT/LT	ST	IT/LT	
Occupational Handler											
Chemical Operator (n=11)	2.99	0.046	4.52	0.193	0.0830	0.00297	520	470	34,000	13,000	450

ST = Short-term duration; IT =Intermediate-term duration; and LT = long-term.

a. The exposure scenario represents a worker wearing long-sleeved shirts, cotton work trousers, and gloves. Gloves were worn only when near chemicals, not when operating the diptank.

b. Dermal and inhalation unit exposures are from the DDAC study (MRID 455243-04). Refer to Table A-2 in Appendix A for the dermal and inhalation unit exposure calculations. Inhalation exposure (mg) was calculated using the following equation: Air concentration (mg/m^3) x Inhalation rate (1.0 m^3/hr) x Sample Duration (8 hr). The inhalation rate is from USEPA, 1997a.

c. The application rate is 4.52%a.i. in treatment solution (formulated product is applied at a rate of 22.6% of the weight of the wood treated, and the product contains 20% a.i.)

d. Absorbed Daily Dose (mg/kg/day) = unit exposure (mg/1% ai solution) * percent active ingredient in solution * absorption factor (43% for dermal IT, and 100% for all other exposures/durations) / body weight (70 kg).

e. MOE = NOAEL (mg/kg/day)/ Daily Dose [Where ST NOAEL = 100 mg/kg/day for dermal and inhalation exposures, and the IT/LT NOAEL = 39 mg/kg/day for all durations]. Target MOE is 100 for dermal and inhalation exposures.

Construction Workers

Not enough data exists to estimate the amount of exposure associated with

construction workers who install treated wood. In particular, values for the transfer coefficient associated with a construction worker handling the wood could not be determined. However, it is believed that the construction worker using a trim saw will have larger dermal and inhalation exposures than the installer, due to the amount of sawdust generated and the greater amount of hand contact that would be necessary to handle the wood when using a saw compared to installing the wood.

6.5 Data Limitations/Uncertainties

There are several data limitations and uncertainties associated with the occupational handler and postapplication exposure assessments. These include:

- Surrogate dermal and inhalation unit exposure values were taken from the proprietary Chemical Manufacturers Association (CMA) antimicrobial exposure study (USEPA, 1999: DP Barcode D247642) or from the Pesticide Handler Exposure Database (USEPA, 1998) (See Appendix A for summaries of these data sources). Since the CMA data are of poor quality, the Agency requests that confirmatory data be submitted to support the occupational scenarios assessed in this document.
- Although the data libraries contained in MCCEM are limited to residential settings, the model can be used to assess other indoor environments. For this assessment, assumptions were made regarding barn dimensions and air changes per hour. The results could be refined with actual ventilation rates. Also the half-life for the chemical would useful to refine the results.
- Currently, no exposure data are available to assess the bystanders' inhalation exposure to OPP vapors in industrial settings. Appropriate air monitoring data in the manufacturing setting are needed to support the preservative uses.

7.0 REFERENCES

Bestari et al., 1999 Measurement and Assessment of Dermal and Inhalation Exposures to Didecyl Dimethyl Ammonium Chloride (DDAC) Used in the Protection of Cut Lumber (Phase III). (MRID 455243-04, Task force #73154).

Cinalli, Christina, et al. A Laboratory Method to Determine the Retention of Liquids on the Surface of Hands. Exposure Evaluation Division. September 1992.

National Institute for Occupational Safety and Health (NIOSH): Criteria for a Recommended Standard-Occupational Exposure to Metalworking Fluids. Department of Health and Human Services (DHHS) NIOSH Publication #98-102 (1998).

SIMetric, 2005. Mass, Weight, Density, or Specific Gravity of Bulk Materials. http://www.simetric.co.uk/si_materials.htm, last accessed June 2005.

USEPA. 1997. Standard Operating Procedures (SOPs) for Residential Exposure Assessments. EPA Office of Pesticide Programs–Human Health Effects Division (HED). Dated December 18, 1997.

USEPA. 1997a. Exposure Factors Handbook. Volume I-II. Office of Research and Development. Washington, D.C. EPA/600/P-95/002Fa.

USEPA 1997b. Risk Analysis for Microban Additive "B" (Triclosan or Irgason DP300) Treated Toys for Infants. Memorandum from Winston Dang, USEPA to Frank Sanders and William Jordan, USEPA. Dated February 27, 1997.

USEPA. 1998. PHED Surrogate Exposure Guide. Estimates of Worker Exposure from the Pesticide Handler Exposure Database Version 1.1. Washington, DC: U.S. Environmental Protection Agency.

USEPA. 1999. Evaluation of Chemical Manufacturers Association Antimicrobial Exposure Assessment Study. Memorandum from Siroos Mostaghimi, Ph.D., USEPA, to Julie Fairfax,

USEPA. Dated November 4, 1999. DP Barcode D247642. (HED's Science Advisory council for Exposure Policy #009. Agricultural Default Daily Acres Treated. April 1, 1999).

USEPA. 2000. Residential SOPs. EPA Office of Pesticide Programs–Human Health Effects Division. Dated April 5, 2000.

USEPA. 2001. HED Science Advisory Council for Exposure. Policy Update, November 12. Recommended Revisions to the Standard Operating Procedures (SOPs) for Residential Exposure Assessment, February 22, 2001.

Whatman, 2005. Whatman Absorbent Sinks. http://www.whatman.com/products/?pageID=7.32.42, Accessed March 2005.

APPENDIX A:
Summary of CMA and PHED Data

APPENDIX A: Summary of CMA data and PHED

Chemical Manufacturers Association (CMA) Data:

In response to an EPA Data Call-In Notice, a study was undertaken by the Institute of Agricultural Medicine and Occupational Health of The University of Iowa under contract to the Chemical Manufacturers Association. In order to meet the requirements of Subdivision U of the Pesticide Assessment Guidelines (superseded by Series 875.1000-875.1600 of the Pesticide Assessment Guidelines), handler exposure data are required from the chemical manufacturer specifically registering the antimicrobial pesticide. The applicator exposure study must comply with the assessment guidelines for "Applicator Exposure Monitoring" in Subdivision U and the "Occupational and Residential Exposure Test Guidelines" in Series 875. For this purpose, CMA submitted a study on 28 February, 1990, entitled "Antimicrobial Exposure Assessment Study (amended on December 8, 1992)" which was conducted by William Popendorf, et al. It was evaluated and accepted by Occupational and Residential Exposure Branch (OREB) of Health Effect Division (HED), Office of Pesticides Program (OPP) of EPA in 1990. The purpose of this CMA study was to characterize exposure to antimicrobial chemicals in order to support pesticide reregistrations (CMA, 1992). The unit exposures presented in the most recent EPA evaluation of the CMA database (USEPA, 1999) were used in this assessment.

The Agency determined that the CMA study had fulfilled the basic requirements of Subdivision U - Applicator Exposure Monitoring. The advantages of CMA data over other "surrogate data sets" is that the chemicals and the job functions of mixer/loader/applicator were defined based on common application methods used for antimicrobial pesticides. A few of the deficiencies in the CMA data are noted below:

- The inhalation concentrations were typically below the detection limits, so the unit exposures for the inhalation exposure route could not be accurately calculated.
- QA/QC problems including lack of either/or field fortification, laboratory recoveries, and storage stability information.
- Data have an insufficient amount of replicates.

The Pesticide Handlers Exposure Database (PHED):

The Pesticide Handlers Exposure Database (PHED) has been developed by a Task Force consisting of representatives from Health Canada, the U.S. Environmental Protection Agency (EPA), and the American Crop Protection Association (ACPA). PHED provides generic pesticide worker (i.e., mixer/loader and applicator) exposure estimates. The dermal and inhalation exposure estimates generated by PHED are based on actual field monitoring data, which are reported generically (i.e., chemical specific names not reported) in PHED. It has been the Agency's policy to use "surrogate" or "generic" exposure data for pesticide applicators in certain circumstances because it is believed that the physical parameters (e.g., packaging type) or application technique (e.g., aerosol can), not the chemical properties of the pesticide, attribute to exposure levels. [Note: Vapor pressures for the chemicals in PHED are in the range of E-5 to E-7 mm Hg.] Chemical specific properties are accounted for by correcting the exposure data for study specific field and laboratory recovery values as specified by the PHED grading criteria.

PHED handler exposure data are generally provided on a normalized basis for use in exposure assessments. The most common method for normalizing exposure is by pounds of active ingredient (ai) handled per replicate (i.e., exposure in mg per replicate is divided by the amount of ai handled in that particular replicate). These unit exposures are expressed as mg/lb ai handled. This normalization method presumes that dermal and inhalation exposures are linear based on the amount of active ingredient handled.

APPENDIX B:
Input/Output from Residential MCCEM Modeling

TITLE: MCCEM Postapplication Adult Exposure to Aerosol Spray (Residential)
RUN Day Hour Min Length Days Hours Min Reporting
TIME Start: 0 0 0 of Run: 1 0 0 Interval: 15 minutes

HOUSE Type: Generic house State: NA Code: GN001
Season: SUMMER Zones: 2 Infiltration Rate: 0.18 ACH

EMISSIONS Source Zone Type Details

1
2
3
4

SINKS Sink Zone Model Details

1
2
3
4
5
6

ACTIVITIES Primary Activity Pattern is used on days: 1, 2, 3, 4, 5, 6, 7
OVERRIDE ACTIVITIES: YES

DOSE
Events/yr: 255 Yrs of Use: 1 Weight(kg): 70 Length of Life(yrs): 75

MONTE CARLO: NO Number of Trials: 1 Seed No: Random

OPTIONS Single Chamber: NO Saturation Concentration (mg/m³): 0 Output Concentration Units: mg/m³

Initial Concentrations Units: µg/m³
Zone 1: 65.6 Zone 2: 0 Zone 3: 0 Zone 4: 0 Outdoors: 0

RESULTS

LADD: 3.5593e-06 mg/(kg day)
LADC: 2.1478e-05 mg/m³
ADD: 0.00026694 mg/(kg day)
ADC: 0.0016109 mg/m³
Single Event Dose: 0.026765 mg

Peak Concentration: 0.064656 mg/m³
APDR: 0.00038235 mg/(kg day)
Time when APDR occurred: 0.33368 days
Average Inhalation Rate: 11.6 m^3/day

TITLE: MCCEM Postapplication Child Exposure to Aerosol Spray (Residential)
NOTES:
EXECUTED FILE: H:\AD\PhenylPhenol\OPP MCCEM Residential Aerosol Postapp Child.mcm
RESULTS SAVED IN FILE: H:\AD\PhenylPhenol\OPP MCCEM Residential Aerosol Postapp Child.csv
RUN Day Hour Min Length Days Hours Min Reporting
TIME Start: 0 0 0 of Run: 1 0 0 Interval: 15 minutes

HOUSE Type: Generic house State: NA Code: GN001
Season: SUMMER Zones: 2 Infiltration Rate: 0.18 ACH

EMISSIONS Source Zone Type Details

1
2
3
4

SINKS Sink Zone Model Details

1
2
3
4
5
6

ACTIVITIES Primary Activity Pattern is used on days: 1, 2, 3, 4, 5, 6, 7
OVERRIDE ACTIVITIES: YES

DOSE
Events/yr: 255 Yrs of Use: 1 Weight(kg): 15 Length of Life(yrs): 75

MONTE CARLO: NO Number of Trials: 1 Seed No: Random

OPTIONS Single Chamber: NO Saturation Concentration (mg/m³): 0 Output Concentration Units: mg/m³

Initial Concentrations Units: µg/m³
Zone 1: 65.6 Zone 2: 0 Zone 3: 0 Zone 4: 0 Outdoors: 0

RESULTS

LADD: 1.2715e-05 mg/(kg day)
LADC: 2.1478e-05 mg/m³
ADD: 0.00095364 mg/(kg day)
ADC: 0.0016109 mg/m³

Single Event Dose: 0.020489 mg
Peak Concentration: 0.064656 mg/m³
APDR: 0.0013659 mg/(kg day)
Time when APDR occurred: 0.33368 days
Average Inhalation Rate: 8.88 m^3/day

TITLE: Residential Fogger
RUN Day Hour Min Length Days Hours Min Reporting
TIME Start: 0 0 0 of Run: 2 0 0 Interval: 15 minutes

HOUSE Type: Generic house State: NA Code: GN001
Season: SUMMER Zones: 2 Infiltration Rate: 0.18 ACH

EMISSIONS	Source	Zone	Type	Details
1				
2				
3				
4				

SINKS	Sink	Zone	Model	Details
1				
2				
3				
4				
5				
6				

ACTIVITIES Primary Activity Pattern is used on days: 1,2,3,4,5,6,7
OVERRIDE ACTIVITIES: YES

DOSE
Events/yr: Yrs of Use: Weight(kg): Length of Life(yrs):

MONTE CARLO: NO Number of Trials: 1 Seed No: Random

OPTIONS Single Chamber: YES Saturation Concentration (mg/m³): NONE Output Concentration Units: mg/m³

Initial Concentrations Units: g/m³
Zone 1: 0.00611 Zone 2: 0.00611 Zone 3: 0 Zone 4: 0 Outdoors: 0

MCCEM Air Concentration Output (.csv) for the Residential Fogging Scenario

Time (hrs)	Conc Inside House (mg/m^3)
0	6.11
0.25	5.84129
0.5	5.58439
0.75	5.33879
1	5.104
1.25	4.87953
1.5	4.66493
1.75	4.45977
2	4.26363
2.25	4.07612
2.5	3.89686
2.75	3.72548
3	3.56163
3.25	3.405
3.5	3.25525
3.75	3.11208
4	2.97522
4.25	2.84437
4.5	2.71928
4.75	2.59968
5	2.48535
5.25	2.37605
5.5	2.27155
5.75	2.17165
6	2.07614
6.25	1.98484
6.5	1.89754
6.75	1.81409
7	1.73431
7.25	1.65804
7.5	1.58512
7.75	1.5154
8	1.44876
8.25	1.38504
8.5	1.32413
8.75	1.2659
9	1.21022
9.25	1.157
9.5	1.10611
9.75	1.05747
10	1.01096
10.25	0.9665
10.5	0.923994
10.75	0.883357
11	0.844508

Time (hrs)	Conc Inside House (mg/m^3)
11.25	0.807367
11.5	0.77186
11.75	0.737914
12	0.705461
12.25	0.674435
12.5	0.644774
12.75	0.616418
13	0.589308
13.25	0.563391
13.5	0.538613
13.75	0.514925
14	0.492279
14.25	0.470629
14.5	0.449931
14.75	0.430144
15	0.411226
15.25	0.393141
15.5	0.375851
15.75	0.359321
16	0.343519
16.25	0.328411
16.5	0.313968
16.75	0.30016
17	0.286959
17.25	0.274339
17.5	0.262273
17.75	0.250739
18	0.239712
18.25	0.229169
18.5	0.219091
18.75	0.209455
19	0.200243
19.25	0.191437
19.5	0.183018
19.75	0.174969
20	0.167274
20.25	0.159917
20.5	0.152884
20.75	0.14616
21	0.139732
21.25	0.133587
21.5	0.127712
21.75	0.122095
22	0.116726
22.25	0.111592
22.5	0.106684

Time (hrs)	Conc Inside House (mg/m^3)
22.75	0.101993
23	0.097507
23.25	0.0932187
23.5	0.089119
23.75	0.0851996
24	0.0814526
24.25	0.0778704
24.5	0.0744457
24.75	0.0711716
25	0.0680416
25.25	0.0650491
25.5	0.0621883
25.75	0.0594533
26	0.0568386
26.25	0.0543389
26.5	0.0519491
26.75	0.0496644
27	0.0474802
27.25	0.0453921
27.5	0.0433958
27.75	0.0414873
28	0.0396627

APPENDIX C:

Calculation of DDAC Unit Exposure Values

Table C-1: DDAC Dermal and Inhalation Exposure Values for Chemical Operators, Graders, Millwrights, Clean-up Crews, and Trim Saw Operators[a]

Replicate Number	Chemical Operator			Grader			Trim Saw Operator			Millwright			Cleanup Crew		
	Dermal	Inhalation		Dermal	Inhalation		Dermal	Inhalation		Dermal	Inhalation		Dermal	Inhalation	
	Potential exposure (mg/day)	Air Concentration[b,c] (µg/m^3)	Potential exposure[d] (mg/day)	Potential exposure (mg/day)	Air Concentration[b,c] (µg/m^3)	Potential exposure[d] (mg/day)	Potential exposure (mg/day)	Air Concentration[b,c] (µg/m^3)	Potential exposure[d] (mg/day)	Potential exposure (mg/day)	Air Concentration[b,c] (µg/m^3)	Potential exposure[d] (mg/day)	Potential exposure (mg/day)	Air Concentration[b,c] (µg/m^3)	Potential exposure[d] (mg/day)
1	3.5	10.4	0.0808	3.05	2.90	0.0232	0.78	2.83	0.0227	1.31	2.92	0.0233	68.3	2.99145	0.0239
2	6.11	2.80	0.0224	7.47	2.93	0.0234	1.98	12.3	0.0984	29.08	2.83	0.0226	0.720	2.78840	0.0223
3	6.07	2.79	0.0223	1.09	2.91	0.0233				8.03	15.6	0.1248	166	30.3	0.2424
4	46.37	2.82	0.0226	10.51	3.00	0.0240							95.2	412	3.2960
5	0.94	2.93	0.0235	0.61	2.82	0.0226							1.20	2.83585	0.0227
6	22.15	2.83	0.0227	0.98	2.85	0.0228							0.260	2.80989	0.0225
7	21.45	2.77	0.0222	2.63	2.91	0.0233									
8	0.22	2.73	0.0218	5.23	2.85	0.0228									
9	0.44	2.77	0.0222	0.19	13.20	0.1056									
10	0.33	3.14	0.0251	1.47	2.89	0.0231									
11	0.29	2.88	0.0230	2.38	2.85	0.0228									
12				4.09	2.81	0.0225									
13				1.03	2.94	0.0235									
Arithmetic Mean	**9.81**	3.51	**0.0281**	**3.13**	3.68	**0.0295**	**1.38**	7.57	**0.061**	**12.8**	7.12	**0.057**	**55.3**	75.6	**0.60**
Minimum	0.22	2.73	0.0218	0.19	2.81	0.0225	0.78	2.83	0.0227	1.31	2.83	0.0226	0.260	2.79	0.0223
Maximum	46.4	10.4	0.081	10.51	13.2	0.106	1.98	12.3	0.098	29.1	15.6	0.125	166	412	3.30

a. *"Measurement and Assessment of Dermal and Inhalation Exposures to Didecyl Dimethyl Ammonium Chloride (DDAC) Used in the Protection of Cut Lumber (Phase III)"* is the study that values were obtained from for this table (Bestari et al., 1999, MRID 455243-04).

b. The inhalation LOD was not provided for chemical operators, graders, trim saw operators, millwrights, or the clean-up crew. Therefore, the LOD provided for the diptank operator (5.6 µg) was used for these positions. Residues less than the LOD were adjusted to 1/2 LOD.

c. The inhalation limit of detection was converted to µg/m^3 using the following equation: air concentration (µg/m^3) = 5.6 µg/ [average flow rate (L/min) * sampling duration (480 min) * 1000 L/m^3. Data was obtained from Bestari et al (1999). Average flow rate of air was collected from where that particular volunteer was.

d. DDAC air concentrations were converted to inhalation exposure (mg/day) using the following equation: Air concentration (µg/m^3) x inhalation rate (1.0 m^3/hr) x Conversion factor (1 mg/1000 µg) x sample duration (8 hours/day)

Table C-2: Normalization of DDAC Dermal and Inhalation Exposure Values for Diptank Operators [a]

Worker ID	Mill number	Sample Time (min)	DDAC Conc. in Diptank (%)	Gloves	Dermal Body Exposure[b] (mg)	Hand Exposure[b] (mg)	Total Dermal Exposure (mg)	Normalized Total Dermal Unit Exposure[c] (mg/ 1 % solution)	Air Conc.[d] (mg/m^3)	Inhalation Exposure[e] (mg)	Normalized Inhalation Unit Exposure[c] (mg /1% solution)
M7P1A	7	480	0.64	Rubber	0.5	3.44	3.94	6.16	0.003	0.024	0.0375
M7P1B	7	480	0.64	Rubber	0.32	2.02	2.34	3.66	0.003	0.024	0.0375
M8P4A	8	408	0.42	Rubber	0.04[f]	1.34	1.38	3.29	0.003	0.024	0.057
M8P4B	8	480	0.42	Rubber	0.04[f]	0.5	0.54	1.29	0.003	0.024	0.057
M8P7	8	480	0.42	Cotton	0.03	0.04	0.07	0.17	0.003	0.024	0.057
M11P9A	11	395	0.63	Leather	0.15	3.33	3.48	5.52	0.003	0.024	0.0381
M11P9B	11	480	0.63	Leather	0.1	0.45	0.55	0.87	0.003	0.024	0.0381
Arithmetic Mean					0.17	1.59	1.76	**2.99**	0.0030	0.0240	**0.046**
Standard Deviation					0.18	1.39	1.53	2.32	0.0000	0.0000	0.0103
Median					0.10	1.34	1.38	3.29	0.0030	0.0240	0.0381
Geometric Mean					0.10	0.83	0.99	1.86	0.0030	0.0240	0.045
90%tile					0.39	3.37	3.66	5.78	0.0030	0.0240	0.057
Maximum					0.50	3.44	3.94	6.16	0.0030	0.0240	0.057

a. *"Measurement and Assessment of Dermal and Inhalation Exposures to Didecyl Dimethyl Ammonium Chloride (DDAC) Used in the Protection of Cut Lumber (Phase III)"* is the study that values were obtained from for this table (Bestari et al., 1999, MRID 455243-04).

b. DDAC concentration that was detected in the monitoring study (MRID #455243-04).

c. Normalization of DDAC data for percent ai treatment. Normalized Unit Exposure (mg/1% ai solution) = Exposure (mg DDAC) / concentration in diptank solution (% DDAC)

d. All inhalation residues were <LOD (5.6 μg or 0.0056 mg/m3). 1/2 LOD was used in all calculations (0.003 mg/m^3). Air Concentration (mg/m3) = 5.6 μg / (~2 L/min flow rate x ~480 min) x 1000 L/m^3 conversion x 0.001 μg/mg = 0.003 mg/m^3

e. Inhalation exposure (mg) = air concentration (mg/m^3) x inhalation rate (1.0 m^3/hr) x sample duration (8 hours/day).

f. Residues were <LOD for dermal samples M8P4A, M8P4B. Sample size of ~11,231 cm^2 x <0.007 $\mu g/cm^2$ = LOD of 0.079 mg. ½ LOD reported (i.e. 0.04 mg)

APPENDIX D:
Input/Output from Occupational MCCEM Modeling

MCCEM SUMMARY REPORT

TITLE: MCCEM Barn Scenario (24-hr REI, 8-hr Exposure)

RUN TIME	Day	Hour	Min		Length of Run:	Days	Hours	Min	Reporting Interval: 15 minutes
Start:	0	0	0			2	0	0	

HOUSE Type: Hypothetical house State: NA Code: HY03
Season: NA Zones: 1 Infiltration Rate: 0.18008 ACH

EMISSIONS	Source	Zone	Type	Details
	1			
	2			
	3			
	4			

SINKS	Sink	Zone	Model	Details
	1			
	2			
	3			
	4			
	5			
	6			

ACTIVITIES Primary Activity Pattern is used on days: 2, 3, 4, 5, 6, 7
OVERRIDE ACTIVITIES: YES

DOSE
Events/yr: 1 Yrs of Use: 50 Weight(kg): 71.8 Length of Life(yrs): 75

MONTE CARLO: NO Number of Trials: 1 Seed No: Random

OPTIONS Single Chamber: NO Saturation Concentration (mg/m^3): 0 Output Concentration Units: mg/m^3

Initial Concentrations Units: g/m^3
Zone 1: 0.177 Zone 2: 0 Zone 3: 0 Zone 4: 0 Outdoors: 0

MCCEM Output for Occupational Foggers - Barn Scenario (REI = 24hrs, TWA = 8 hrs)

Time (hrs) [a]	Conc Zone 1 (mg/m^3) [b]
24	2.34926
24.25	2.24584
24.5	2.14697
24.75	2.05246
25	1.9621
25.25	1.87573
25.5	1.79315
25.75	1.71421
26	1.63875
26.25	1.5666
26.5	1.49764
26.75	1.43171
27	1.36868
27.25	1.30843
27.5	1.25083
27.75	1.19576
28	1.14312
28.25	1.0928
28.5	1.04469
28.75	0.998698
29	0.954732
29.25	0.912702
29.5	0.872522
29.75	0.834111
30	0.797391
30.25	0.762288
30.5	0.72873
30.75	0.696649
31	0.66598
31.25	0.636662
31.5	0.608634
31.75	0.58184
32	0.556226
8-hr TWA [c]	1.25

a Time (hrs) = Hours after fogging occurs
b Conc. Zone 1 = air concentration in room being fogged
c 8-hr TWA (Time Weighted Average) = average concentration over an 8-hr period (e.g. hours 24 through 32)

APPENDIX E:
Wallpaint Exposure Model (WPEM) Outputs

Air Concentrations for Professional Painters from WPEM

Time (hrs)[a]	Conc@Person (mg/m^3)[b]
0	0
1	1.98738
2	6.14056
3	10.842
4	15.3683
5	19.4515
6	23.0419
7	26.1839
8	28.9536
9	31.4292
9-hr TWA	18.16

a Time (hrs) = Hours after painting activities begin; note that time 0 represents the time when the painting begins
b Air concentration inhaled by painter
c 9-hr TWA (Time Weighted Average) = average concentration over an 9-hr period (e.g. hours 1 through 9)

Air Concentrations for DIY Painter

Time (hrs) [a]	Conc Zone 1 (mg/m^3) [b]	Conc@Person (mg/m^3) [c]
0	0	0
1	0.521529	0.521529
2	1.18451	1.18451
3	1.74769	1.74769
4	1.9753	0
	Max. 3-hr Avg [d]	1.15

a Time (hrs) = Hours after painting activities begin; note that time 0 represents the time when the painting begins
b Conc. Zone 1 = air concentration in room being painted
c Conc. @ person = air concentration being inhaled by the DIY painter during the painting activities
d The model assumes that it takes a DIY painter approximately 3 hours to paint one room. Therefore, the maximum 3-hr average (e.g., hrs 1, 2, and 3) of conc@person was used in the exposure assessment

Air Concentrations for Residential Child Exposure (24-hr Exposure)

Time (hrs) [a]	Conc Outdoors (mg/m^3)	Conc Zone 1 (mg/m^3)[b]	Conc Zone 2 (mg/m^3)[c]	Conc@Person (mg/m^3)[d]
0	0	0	0	0
1	1.66E-59	1.34333	0.111125	0.111125
2	1.09E-58	3.05102	0.465527	0.465527
3	3.08E-58	4.50163	0.920322	0.920322
4	6.15E-58	5.70673	1.37936	6.15E-58
5	1.01E-57	5.34545	1.68663	1.68663
6	1.41E-57	4.50329	1.70397	1.70397
7	1.79E-57	3.8085	1.57669	1.57669
8	2.12E-57	3.27633	1.40645	1.40645
9	2.42E-57	2.87919	1.24103	1.24103
10	2.68E-57	2.58719	1.09896	1.09896
11	2.92E-57	2.37415	0.984513	2.37415
12	3.13E-57	2.21896	0.895679	2.21896
13	3.33E-57	2.1054	0.828198	2.1054
14	3.51E-57	2.02137	0.777492	2.02137
15	3.69E-57	1.95807	0.739473	1.95807
16	3.85E-57	1.9092	0.710801	1.9092
17	4.02E-57	1.87033	0.688885	1.87033
18	4.17E-57	1.83834	0.671786	1.83834
19	4.33E-57	1.81109	0.658084	1.81109
20	4.48E-57	1.78711	0.646763	1.78711
21	4.63E-57	1.76538	0.637102	1.76538
22	4.78E-57	1.74522	0.628597	0.628597
23	4.93E-57	1.72617	0.620897	4.93E-57
24	5.07E-57	1.70791	0.613763	5.07E-57
			24-hr TWA	1.35

a Time (hrs) = Hours after painting activities begin; note that time 0 represents the time when the painting begins
b Conc. Zone 1 = air concentration in room being painted
c Conc. Zone 2= air concentration in room not being painted
d Conc. @ person = air concentration being inhaled by the child due to being in the vicinity of the freshly painted room. Based on activity patterns, WPEM assumes that the child may be in zone 1, zone 2 or outdoors.

Air Concentrations for Residential Adult Exposure (24-hr Exposure)

Time (hrs) [a]	Conc Outdoors (mg/m^3)	Conc Zone 1 (mg/m^3)[b]	Conc Zone 2 (mg/m^3)[c]	Conc@Person (mg/m^3)[d]
0	0	0	0	0
1	1.66E-59	1.34333	0.111125	0.111125
2	1.09E-58	3.05102	0.465527	0.465527
3	3.08E-58	4.50163	0.920322	0.920322
4	6.15E-58	5.70673	1.37936	6.15E-58
5	1.01E-57	5.34545	1.68663	1.01E-57
6	1.41E-57	4.50329	1.70397	1.41E-57
7	1.79E-57	3.8085	1.57669	1.79E-57
8	2.12E-57	3.27633	1.40645	1.40645
9	2.42E-57	2.87919	1.24103	1.24103
10	2.68E-57	2.58719	1.09896	1.09896
11	2.92E-57	2.37415	0.984513	0.984513
12	3.13E-57	2.21896	0.895679	0.895679
13	3.33E-57	2.1054	0.828198	0.828198
14	3.51E-57	2.02137	0.777492	2.02137
15	3.69E-57	1.95807	0.739473	1.95807
16	3.85E-57	1.9092	0.710801	1.9092
17	4.02E-57	1.87033	0.688885	1.87033
18	4.17E-57	1.83834	0.671786	1.83834
19	4.33E-57	1.81109	0.658084	1.81109
20	4.48E-57	1.78711	0.646763	1.78711
21	4.63E-57	1.76538	0.637102	1.76538
22	4.78E-57	1.74522	0.628597	0.628597
23	4.93E-57	1.72617	0.620897	4.93E-57
24	5.07E-57	1.70791	0.613763	5.07E-57
			24-hr TWA	0.98

a Time (hrs) = Hours after painting activities begin; note that time 0 represents the time when the painting begins
b Conc. Zone 1 = air concentration in room being painted
c Conc. Zone 2= air concentration in room not being painted
d Conc. @ person = air concentration being inhaled by the adult bystander due to being in the vicinity of the freshly painted room. Based on activity patterns, WPEM assumes that the child may be in zone 1, zone 2 or outdoors.